JUNE • 1956
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C. J. Covington, Dowzer Electric Machinery Works, Inc., Mt. Vernon, Ill., elected president of NISA.
Page 193

Special report on the electrical features of new GM Tech Center
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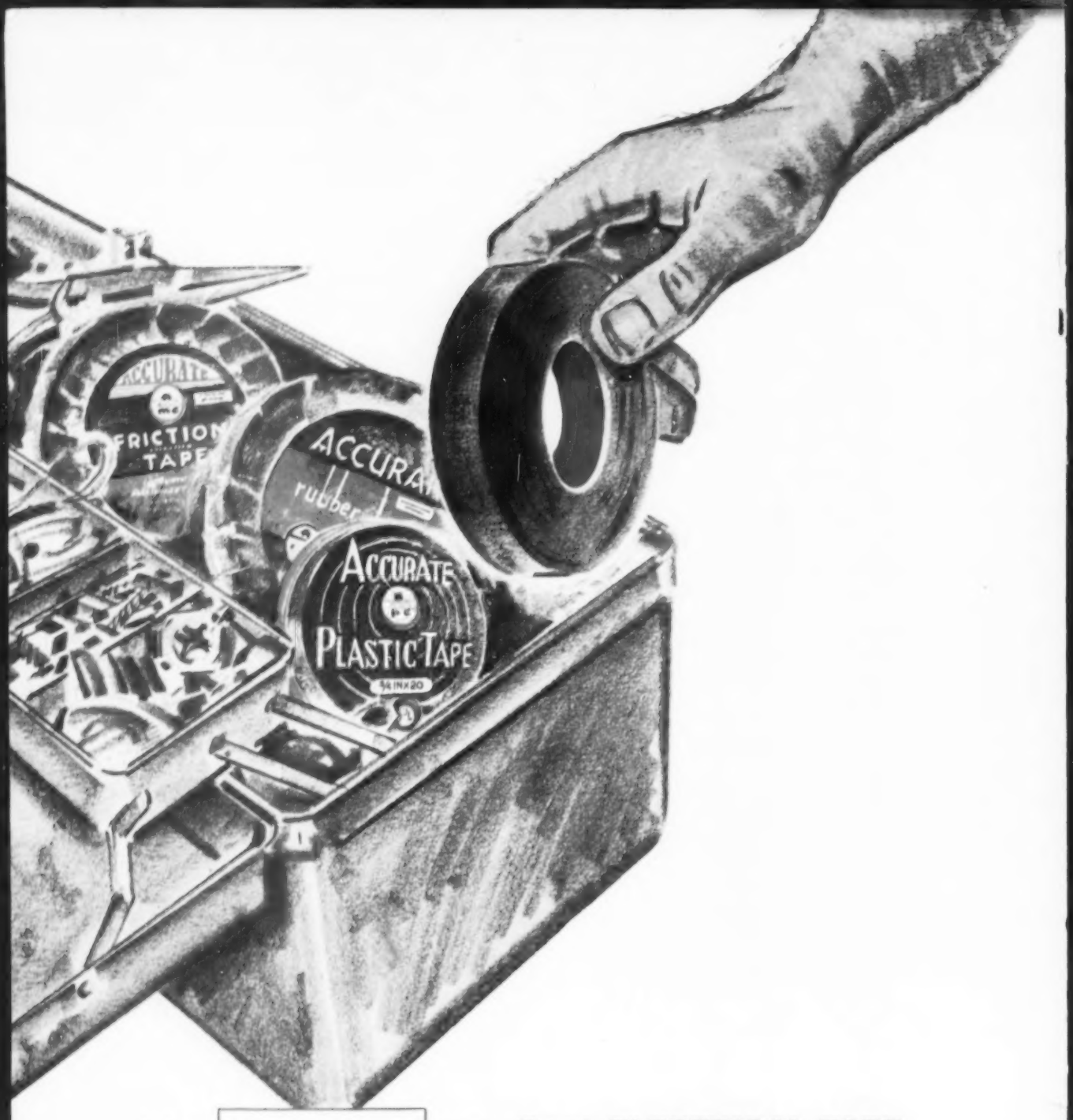
55TH YEAR



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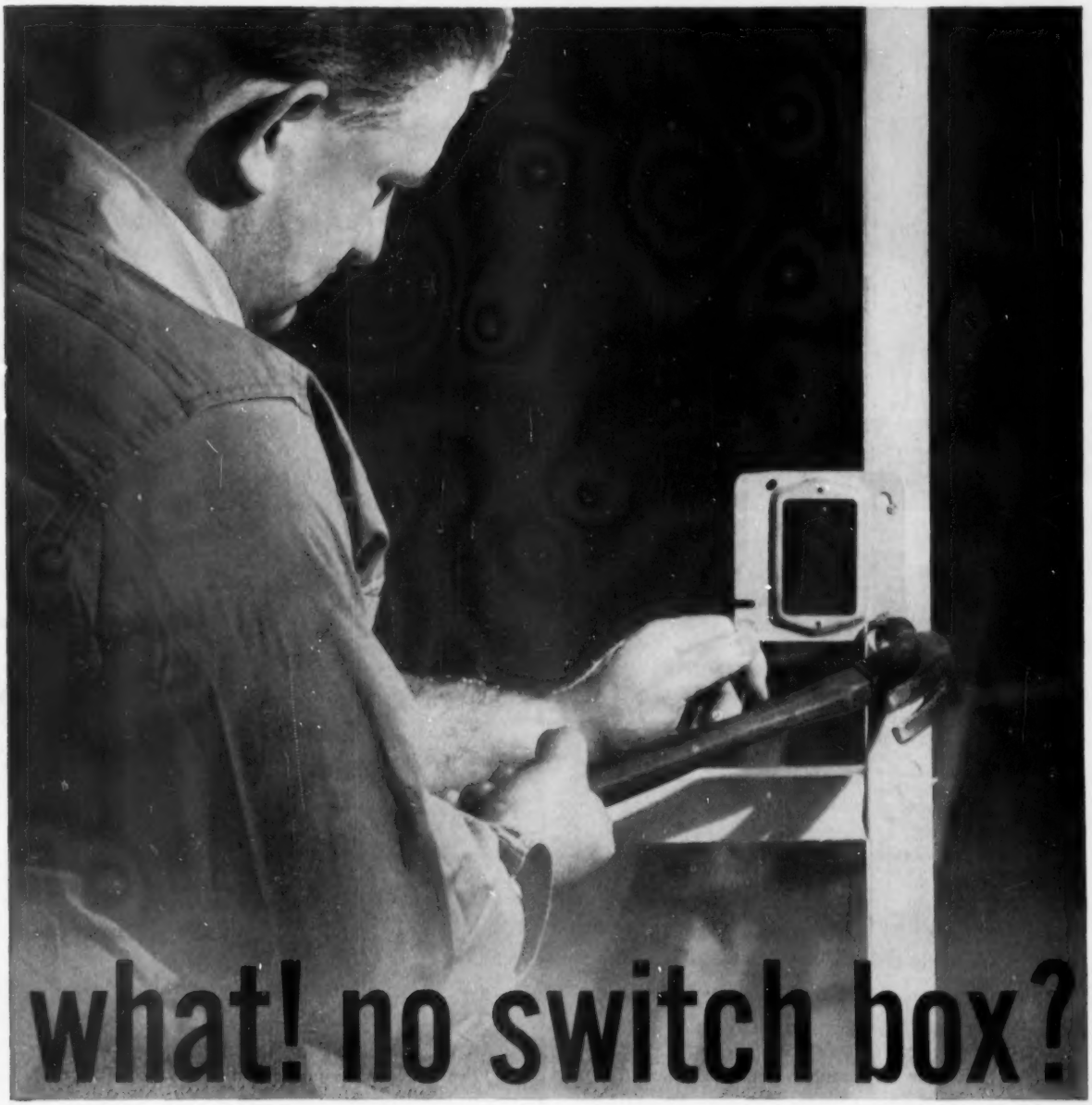

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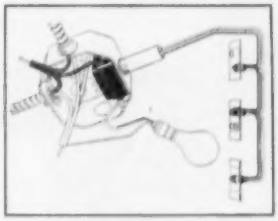

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—Sidelights—

G.M. TECH CENTER—General Motor's fabulous new Technical Center incorporates many advanced techniques of environment engineering. Lighting is an integral part of the creative environment achieved by the designers. Multi-functional electric ceilings have modular circuiting for flexibility. Fluorescent systems operate on 480 volts with low-voltage area control. Dimmer control of mercury vapor lighting is also among the advanced methods employed in the project. Highlights of the job are presented in "Lighting at General Motors Technical Center" beginning on page 84.

CEILING JURISDICTION – Craft jurisdiction questions arising from lighting system installations have been answered in detail by a joint agreement between the electricians and carpenters. The report is highly specific and defines the areas subject to the jurisdiction of each craft by means of detailed drawings. In preparing our report on this agreement, "Unions Define Ceiling Jurisdiction," page 81, the original drawings were modified to give additional contrast to the craft areas by means of color. The red portion belongs to the electricians, the black portions to the carpenters.

HIGH CYCLE POWER—Recent developments in the use of frequencies above 60-cycle for fluorescent lighting have focused renewed industry attention on the high-cycle range of power frequencies and their potential industrial uses. The report this month by Vernon C. Geckler, Plant Engineer of the New Departure Division of General Motors, on "Industrial Uses of High-Cycle Power," page 113, is particularly timely. He gives many pertinent facts on the application, installation, operation, and maintenance of 300- to 2000-cycle systems with derating data for high-cycle use of 60-cycle control equipment.

LIFT-SLABS—More practical job methods on the unique method known as lift-slab construction are given in an article this month on the building of a new Portland, Ore., high school. The report illustrates methods devised by the Jaggar-Sroufe Co. for anchoring outlets and maintaining raceway continuity between slabs. See "Contractor Devises Methods for Wiring Lift-Slabs," page 100.

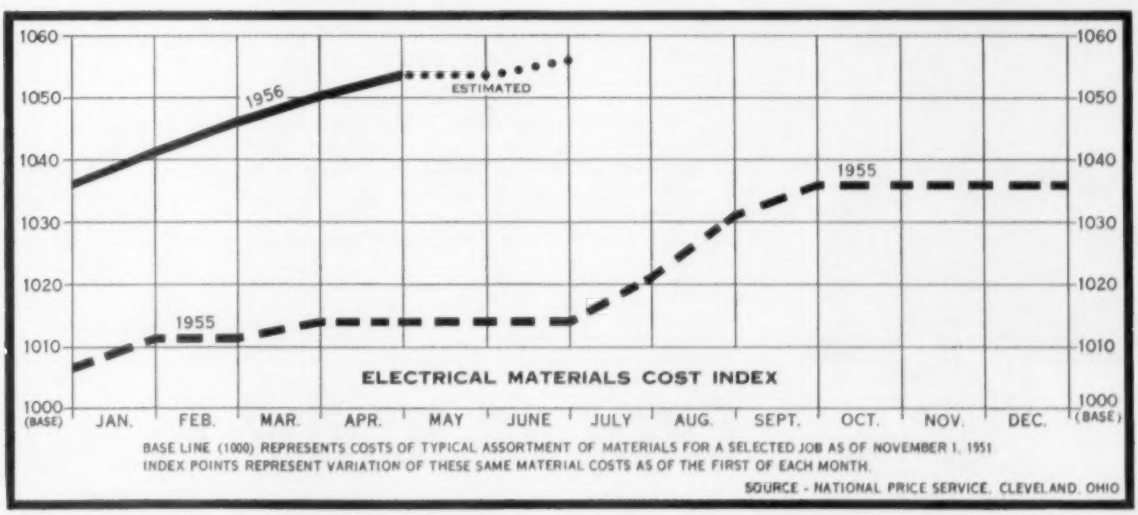
BEACONS—Four sweeping searchlights atop the Empire State Building gives New York a distinctive marker visible to planes for 300 miles around. Each 450-million candlepower beacon sweeps a vertical and horizontal area in a controlled sequence operated by an automatic electronic control system. Details of the electrical work, installed by L. K. Comstock Company, are given in "2-billion-candlepower for Empire State Beacon," page 98.

BUSINESS BUILDERS—A new electric truck and bus engine heater has a 1000- to 2500-watt thermostat-controlled element connected to the engine cooling system. The coolant circulates at about 130 degrees insuring on-schedule cold weather starting for equipment parked outdoors. The heaters are cord-connected to post-mounted weatherproof receptacles backed up by a 120/240-volt high-capacity wiring system, usually one circuit per outlet. Sounds like a good item to suggest to your dairy, brewery, frozen-food distributor or bus company customers.

Home fire alarm systems are doing very well these days. Reports are that they are easy to sell, make good "door-openers" for residential electrical modernization, or an acceptable "extra" to push on residential jobs.

Now's the time to remind your customer about that full circuit outlet on the porch or patio. It takes the broiler-rotisserie or fry-pan out of the air conditioned house.

The extra-room building season is on. Usually provisions for heating involve expensive alterations to existing heating systems. Suggest the installation of an electric heating panel or baseboard.



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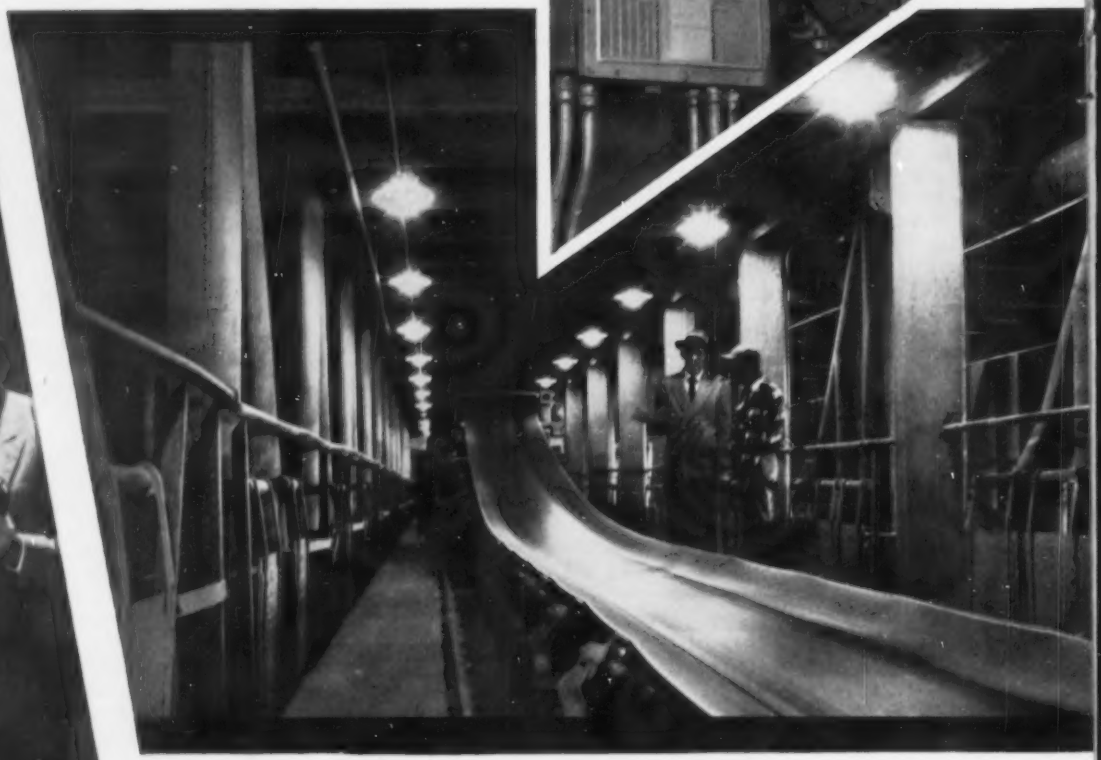

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Washington Report

Talk of inflation worries Administration officials as business levels off at an annual rate of about $400 billion. One reason is, of course, its possible effect on the upcoming national election. It caused Dr. Arthur Burns, chairman of President Eisenhower's Council of Economic Advisers to report in mid-May that "prospects are good the nation can maintain a high-level economy and at the same time stave off inflation."

Dr. Burns said "many of the forces that have recently kept the overall levels of consumer prices stable can be counted on to operate in the years ahead," and pointed out that private and public policies during the past four or five years have resulted in an "approximately steady" value of the dollar. "Opportunities created by expanding markets, by advances in technology, by business innovations and by improved management bid fair to continue the upward trend of industrial productivity," he said. "Pressure of wages on prices will therefore continue to be counteracted by a progressive tendency to increase output per unit of labor."

Some recent reports on economic indicators are as follows:

- Capital spending set a record in 1955, is now predicted to jump 30% this year, with planning through 1959 in excess of the 1955 rate.
- Inventories are at a new high, and credit remains tight through FRB manipulation, helping to remove threat of inflation.
- Electric power output continues to outpace the 1955 rate by about 12%.
- Expenditures for new construction work in April were $3.3 billion, 9% ahead of March and equal to the April 1955 total.
- Total civilian employment in mid-April was almost 64 million, a record for the month, and 2.3 million more than during April 1955. Manufacturing employment, which usually drops substantially between mid-March and mid-April, dropped only slightly this year, overall, in spite of cut-backs in employment in the auto industry.
- Steel production continues at about 95-97% of capacity (128,000,000 plus net tons annually) in spite of drop in auto production, and some curtailment in electric appliance production. Steel producers predict continuing good demand, except for decline in operations due to furnace repairs and vacations during July and August.
- Auto output keeps sagging, with production for year now predicted at 5.8 million cars, down from 1955's record of 7.9 million, and 11% lower than was forecast for the year last January.
- Orders for copper and brass mill products are down sharply, with copper stocks at highest peak in eight years. Copper prices are weakening as a result.

A $50 billion highway building program seemed certain late in May, along with new taxes to pay for it. The House approved such a proposed plan, and passed it on to the Senate for acceptance. Under the plan, Federal taxes would be boosted on gasoline and diesel fuel, tires, trucks, buses and trailers. The plan embraces a 40,000 mile system of super highways.

This is Foreman Joe Wojtalewicz, a member of SPANG's inspection team at Etna. He checks the plating thickness of each lot of SPANGLEAM EMT by means of the Preece Test to be sure the finish more than meets minimum requirements, giving you a top-quality finish on your SPANGLEAM order.

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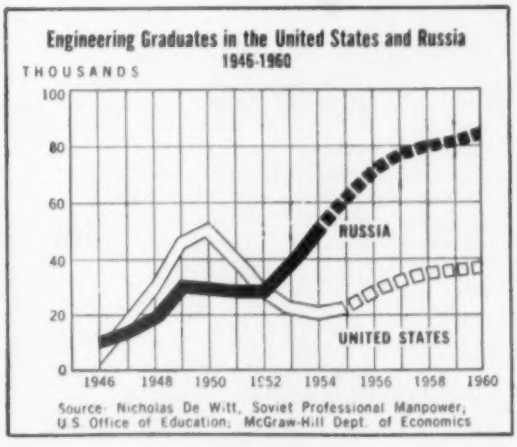
THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

Are We Losing the Race with Russia?

THERE is new confidence in the Kremlin. One key reason is expressed in a recent boast of Communist Party Secretary Khrushchev: **"The capitalists always regard our people as being backward, but today we have more engineers and more supporting engineering technical personnel than any capitalist country."** He promised that this lead would be widened and that communism would be victorious without war.

This boast cannot be dismissed as communist propaganda. Admiral Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, has warned: **"In five years our lead in the training of scientists and engineers may be wiped out, and in ten years we could be hopelessly outstripped. Unless immediate steps are taken to correct it, a situation, already dangerous, within less than a decade could become disastrous."**

This second editorial in a series on the shortage of scientists and engineers is designed to explore as carefully as possible the facts and the implications of the new emphasis on technical training in the Soviet Union. It draws heavily from the authoritative book *Soviet Professional Manpower*, prepared for the National Academy of Sciences and the National Research Council by Nicholas DeWitt of the Russian Research Center of Harvard and released recently by the National Science Foundation.



Trend Is Against Us

If the Soviet Union already has a lead in technical manpower, it is not very great. Both the United States and Russia now have around a million scientists and engineers. About a third of the Russian engineers were trained on inferior pre-1935 standards. **It's the trend — shown in the chart — that is alarming.**

Over the last five years we have turned out only 142,000 engineers, compared to an estimated 216,000 in Russia. In 1955 our output was around 23,000 compared to their 63,000. Over the next five years our projected output is 153,000, against at least 400,000 in Russia. There will be an additional 150,000 or more in the satellites and Red China.

In Russia, 30% of the college students are in engineering, compared to 8% here. Another 30% or more take degrees in natural sciences. Moreover, unlike ourselves, the Russians are

ploughing back a large proportion of their science graduates into teaching, which implies a rapid buildup in the future.

Quality As Well As Quantity

It would be foolhardy to assume that these new Russian graduates are inferior to ours in the quality of their technical training. They start out with much more intensive mathematical and scientific preparation at the high school level. They study harder and longer in college, with more laboratory work and more practical training. Their courses and textbooks seem to be as thorough as ours. Even though the Russian graduates may be overspecialized, they get results.

These results have been striking. The Russians developed both A-bombs and H-bombs faster than we expected, and it's not certain that they had to rely much on espionage. They pushed ahead of us for a while in jet fighter design, and they showed up with a fleet of long-range bombers well ahead of schedule. They are crowding us on nuclear power, electronics and automation. There are grave fears that they have established a lead in the vital field of military rockets.

The goal of Soviet scientific manpower policy includes not only weapon supremacy but also leadership of the neutral and uncommitted areas of Asia, Africa and the Middle East. The Soviet leaders may be bluffing in their offers to export capital, but they are preparing to export Russian scientific and technical know-how in a big way.

How They Do It

The Russians are determined to win the race for scientific supremacy, and they do not count the cost. **They pay their scientists and engineers salaries that seem fantastic when compared with other Soviet incomes.**

Senior professors, research scientists and top engineers are a major segment of the Russian elite. Their incomes are frequently six to ten times the average industrial wage. (In the U. S. six to ten times the average industrial wage would be $25,000 to $40,000 a year.) Housing and other privileges are correspondingly lavish. While preaching equality, the Soviets use capitalistic incentives far more boldly than we do. Indeed, practicing engineers and scientists have been complaining about the exalted status of professors and top research people, and salary scales are now being adjusted to give greater emphasis to practical results.

The Russians are also generous in their aids to education. Tuition has just been made free at all levels. Undergraduates receive 200 to 500 rubles a month and graduate students 800 rubles (about equal to an industrial wage) to cover living expenses. The biggest stipends go to science and engineering students. College students are deferred from military service, and engineers and scientists often enjoy continued deferment even after graduation.

Finally, the Soviet leaders can channel engineers and scientists — and all other human and material resources — into any area they choose. And the areas the Soviet leaders choose are predominantly those that contribute to military or political objectives, rather than to a better life for consumers.

What's Our Answer?

We are certainly not going to adopt Soviet methods. We do not want scientific robots, but free men, able to understand and add to our democratic heritage. At the same time, our world leadership in technology — and perhaps even our survival as a nation — will be threatened if we allow ourselves to lag far behind Russia in the training of scientists and engineers. Ways to keep the United States in the race will be discussed in a later editorial in this series.

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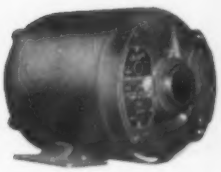

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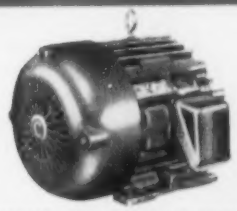

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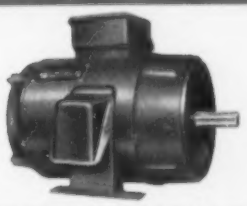

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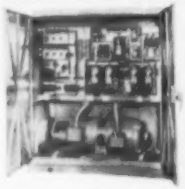

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(fill in numbers here) .....

.....

.....

Name ..... *Title* .....

Company .....

Address .....

City ..... *Zone* ..... *State* CE-57A

GEORGE L. STANDRING MEMORIAL HOSPITAL, Seattle, Wash., is the last word in modern design. American Electrical Co., electrical contractors, used Rome Synthinol Type TW building wire and Rome • EMT throughout . . . another quality job that builds the kind of reputation you want.

They're

KNOLLWOOD PLAZA, a seven-million-dollar shopping center in Minneapolis, Minn., comprises 32 stores, occupies 35 acres. The electrical contractor, Parsons Electric Co., Minneapolis, specified miles of Rome Type TW, RH-RW building wire and RoMarine-RoPrene power cable in a wide range of sizes. For the reasons, see text opposite.

CITY-COUNTY HOSPITAL, Dallas, Texas, used over 1,000,000 feet of Rome Cable products, including Rome Synthinol® Type TW building wire and RoMarine-RoPrene power cable.

Cable, Ling and Telkamp Electric Co., Dallas, was the electrical contractor. Said this firm: "At no time was this project delayed for not having cable available when needed . . . Not a single failure was experienced due to installation breakdown in any manner . . . We can offer only the highest recommendation for your products."

Henry Cable

James Ling

Edward Telkamp

as different as they are miles apart . . .

except for one thing

Thousands of miles separate the buildings shown opposite. All are different in architectural design. Each was wired by a different electrical contractor. Yet, all have one thing in common.

Each contractor used Rome Cable products such as Rome Synthinol® thermoplastic building wires, RoMarine-RoPrene® power cables and Rome•EMT electrical metallic tubing.

And the common denominator of these products, in fact, of *all* Rome products is quality—quality that minimizes your installation costs.

RoMarine-RoPrene, U/L approved as Type USE for 600 volts, can be used in so many ways, it will pay you to check *all* of its advantages.

Rome Synthinol® Type TW, U/L approved for 600 volts at 60° C in dry or wet locations, is a superior small diameter, waxy smooth building wire, easy to handle and pull.

Rome•EMT, U/L approved, meets *all* requirements for safe steel raceways. It is exceptionally corrosion resistant, easy to install, easy to fish.

For example, Rome Synthinol Type TW building wire, approved for wet or dry locations, is highly resistant to heat, sunlight, oils, acids, alkalies, moisture and flame. Waxy smooth with small diameters, it is easy to pull, easy to strip. You save time. Once installed, you can forget it.

RoMarine-RoPrene is a multi-purpose cable you can use for aerial, duct or direct-in-earth installation. It combines RoMarine, heat- and moisture-resistant rubber insulation, with the ruggedness of a RoPrene (Neoprene) sheath. Its versatility simplifies installation and reduces inventory investment.

Rome•EMT, with its slick inside finish, makes fishing and wire pulling so easy you save valuable man-hours. It's designed for one-man handling, with threadless compression joints, making Rome•EMT easy to work and install.

These are the reasons why more and more electrical contractors take advantage of Rome products and one-source responsibility. You have everything to gain and nothing to lose by asking your electrical distributor or any Rome Cable office for information and prices on your next wiring job.

It Costs Less to Buy the Best

ROME CABLE Corporation
ROME • NEW YORK
and
TORRANCE • CALIFORNIA

here's why GrateLite* is great!

Louver-Diffuser

eye comfort you can measure
300 F.C. with only
1.11 C.P./Sq. In. Brightness

and here are the figures to prove it . . .

Foot-Candles, Efficiencies, Brightness Readings

In our own showrooms we've installed a 13' x 16' GrateLite Ceiling. By switching on various lamp arrangements we can deliver from 28 to 300 foot-candles 7' 9" below the GrateLites. Measurements at right give GrateLite efficiency figures and brightness readings at 30° and 45° below the ceiling.

THESE FIGURES PROVE GRATELITE in a class by itself for modern high intensities, safely within comfort ranges plus a high degree of diffusion.

AREA: *15' x 16' (240 Sq. Ft.)*
GRATELITES: *Suspended 18" below ceiling*
FT.-CANDLES: *Taken 7' 9" below GrateLite*
BRIGHTNESS READINGS: *Taken with "Spectra" Electronic Meter*
LUMINAIRES: *Guth M-5385/TO*
ROOM COLORS: *3 walls—light green—60% R. F. Floor—15% R. F.*

Row No.	No. of 8' Lamps & M. A.	Total Lamp Wts.	Foot-Candles With GrateLites	Foot-Candles Less Lvrs.	EFF. With & Without	Brightness At 30° F. L.*	Brightness At 30° C. P.† Per Sq. In.	Brightness At 45° F. L.*	Brightness At 45° C. P.† Per Sq. In.
1	8 @ 200	400W	28	36	78%	80	0.11	80	0.11
2	16 @ 200	800W	50	75	77%	380	0.22	110	0.24
3	24 @ 200	1200W	85	108	78%	130	0.23	140	0.31
4	24 @ 420	1680W	135	170	79%	300	0.43	210	0.48
5	8 @ 200 24 @ 420	2280W	180	200	83%	330	0.51	250	0.55
6	16 @ 200 24 @ 420	3080W	190	230	82%	380	0.64	325	0.72
7	24 @ 200 24 @ 420	3480W	210	260	81%	330	0.73	380	0.7
8	48 @ 420	3960W	240	310	77%	380	0.84	530	1.15
9	8 @ 200 48 @ 420	4080W	255	340	76%	400	0.81	570	1.26
10	16 @ 200 48 @ 420	4480W	285	360	79%	470	1.04	630	1.37
11	24 @ 200 48 @ 420	4920W	300	380	33%	500	1.11	650	1.43

*F. L.—Foot Lamberts †C. P.—Candlepower

It's all in the sight-saving cubes—and only GrateLite has them!

Send for free booklet "The GrateLite Story" Also "Glare Factors" and "Visual Comfort Indexes".

Guth EDWIN F. GUTH CO. • ST. LOUIS 3, MO.

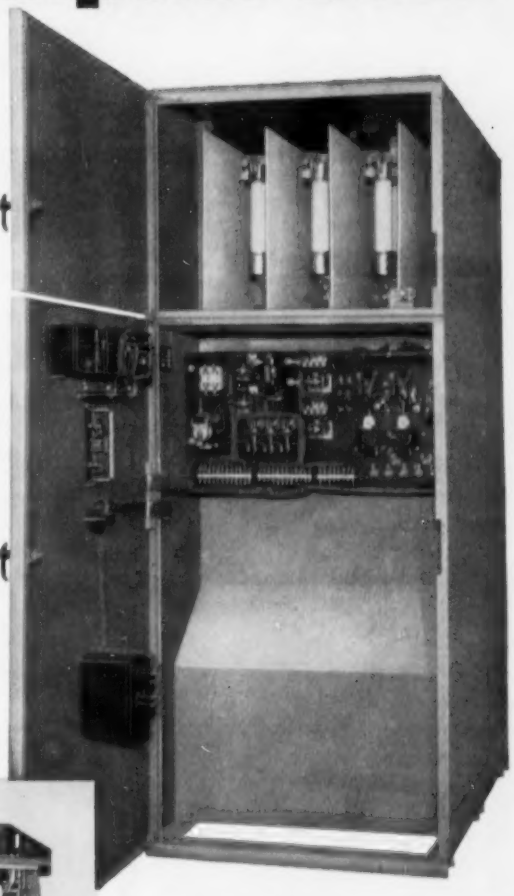
Leaders in Lighting since 1902

Complete "Line-to-Load"

MOTOR *Control and Protection*

ALLIS-CHALMERS
Type H Starters
FOR 2300 TO 5000 VOLT MOTORS

in ONE Compact Unit



THE Allis-Chalmers Type H high voltage starter is a complete control unit. Everything needed for efficient motor control and positive protection is engineered into one easy-to-install cubicle.

Control functions, varying with specific job applications, include full or reduced-voltage starting, acceleration, speed control, reversing or non-reversing, and dynamic braking.

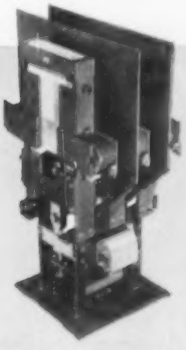
A few of the many protective features

Current-Limiting Fuses clear short circuit in less than ½ cycle . . . long before short can damage contactor or motor.

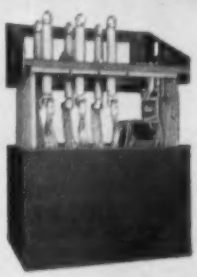
Overload Thermal Relay adjusts for ambient temperatures . . . trips only on motor overload. Allows use of maximum capacity.

Time-Delay Undervoltage Relay permits restarting if power is restored within its setting.

Compartmented Enclosures isolate high voltages. Dead front construction and electrical interlock on fuse compartment provide additional personnel protection.



Choice of Air or Oil Contactors



For complete information, see your Allis-Chalmers representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 14B6410B.

A-4580

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

THE *Suburbanite* LINCOLN, NEBRASKA
ARCHITECT: UNTHANK & UNTHANK

ROTO-GLO® MERCHANDISING HELPS SELL 100 HOMES IN 60 DAYS

Like all builders, Strauss Bros., of Lincoln, Nebraska, aim for quick sales. Every element of their homes is selected not only for quality, but for salability. That's why Strauss Bros. chose ROTO-GLO! Pass & Seymour's top engineering and design have made ROTO-GLO durable, smooth operating and smart appearing, while cutting installation costs. ROTO-GLO national advertising in the "shelter" magazines has made it the most talked about switch among home-buyers, and it costs *only pennies more.*

To cash in on ROTO-GLO's popularity, Strauss Bros. made full use of Pass & Seymour's merchandising aids to present ROTO-GLO switches as a quality feature of their homes. A colorful mobile was displayed at the entrance of each home. Display cards pointed up the national advertising and tied it in with the model home. An eye-catching tag was suspended from every ROTO-GLO switch, to tell the full story of exclusive roto-action, glowing knob and quiet operation.

You, too, should take advantage of Pass & Seymour's ROTO-GLO merchandising. For your FREE supply of *new* mobiles, display cards, switch tags and newspaper advertising mats, see your wholesaler or write direct to Dep't. ECM-15.

P&S **PASS & SEYMOUR, INC.**
SYRACUSE 9, NEW YORK
71 Murray St., New York 7, N. Y. 1229 W. Washington Blvd., Chicago 7, Ill.
In Canada: Renfrew Elec. & Refrig. Co., Ltd., Renfrew, Ontario

Always in DEPENDABLE SUPPLY!

U. S. Royalastic PLASTIC TAPE

This versatile tape does the work of both rubber *and* friction tapes on many jobs. Complete mechanical and electrical protection. Good tensile strength and high resistance to water, oils, acids, alkalies, corrosive chemicals. Easy to manipulate in cramped spots. Good stretch and adhesion. Approved by Underwriters' Laboratories, Inc.

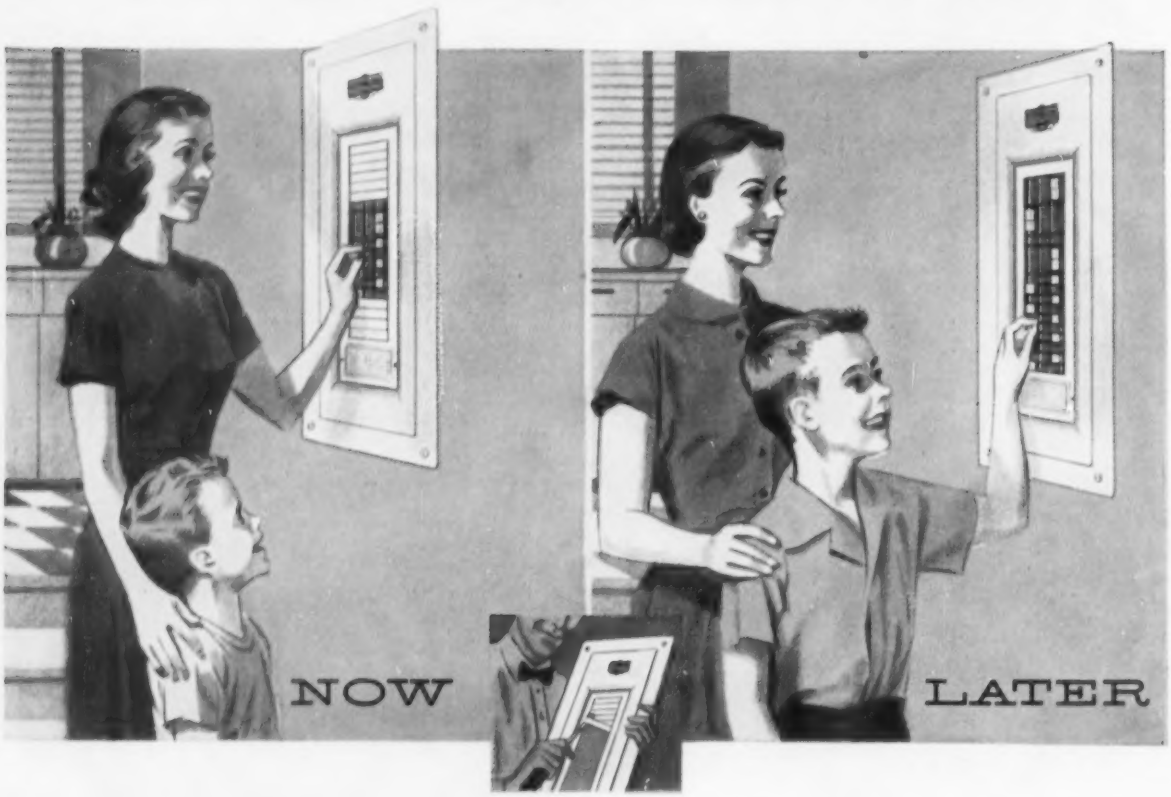
You can get immediate delivery by getting in touch with any of United States Rubber Company's many distributors, any of the 27 "U. S." District Sales Offices, or write us at Rockefeller Center, New York 20, New York.

US RUBBER

Mechanical Goods Division

United States Rubber

Cutler-Hammer Unit Breakers
A load center with a future



Electrical contractors have added a new increment to their "yardstick" for measuring today's circuit protection systems . . . "growing room" for future expansions. Not only are expandable homes common today, but invariably the homes that are built today will not be electrically complete for many years. Over a period of years a homeowner will add major appliances, power tools, air conditioners and so on. Experienced contractors all over the country have met this demand by recommending and installing Cutler-Hammer Unit Breakers . . . the load center with "growing room" and low initial cost.

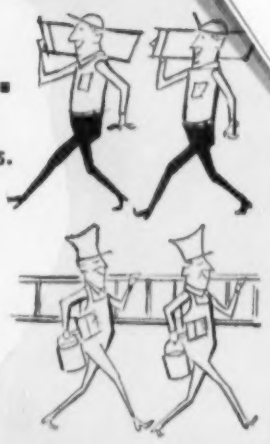
Both contractor and homeowner alike have found it amazingly economical to install a C-H unit breaker combination consisting of a case and bus of sufficient size and capacity to meet future demands plus only the necessary circuit breakers to protect the present load. Homeowners not only appreciate the convenience and safety of circuit breakers, but gone is the clutter of "after-thought" fuse boxes. Contractors praise the simplicity and low cost of stocking only six standard case and cover sizes, and seven breaker sizes. Cutler-Hammer Unit Breakers are available in graduated sizes up to 32 single pole breakers with a 200 ampere bus or 6 double pole breakers and 10 single pole breakers with a 200 ampere split bus.

No other load center is easier to install . . . solderless line connectors, snap-in breakers, straight-wire line terminals and a host of other plus features. Flush or surface mounted units. Twist-out louver cover construction maintains a neat appearance regardless of the number of breakers actually installed.

See your Authorized Cutler-Hammer Distributor for the whole story of how you can serve your customers with a brighter electrical future. Stock on hand. Ask for your copy of the pocket-size Handilog and selector guide. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wis.

CUTLER-HAMMER
UNIT BREAKER
C-H

THE LIGHTS THAT GO IN WHEN THE PAINTERS GO OUT...

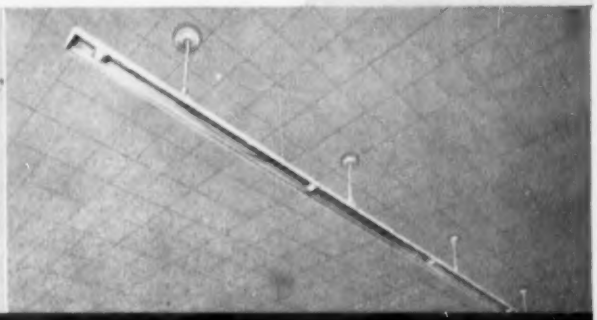


No On-Job Storage. No Paint-Spattered Fixtures. 50% Savings on installation costs.

Gibson ORTHO Fixtures need not be stored on the job where they're in the way of workmen and in danger of damage. Actually, Gibson ORTHO Fixtures can be delivered to the job the day before occupancy, because each fixture simply snaps into place in a matter of seconds, just as it comes from the box —sparkling clean, factory-fresh.

If you're interested in better lighting with savings of more than 50% on installation costs, then you really ought to know more about the Gibson ORTHO Line for industrial and commercial applications. Drop us a line. We'll send you the whole story.

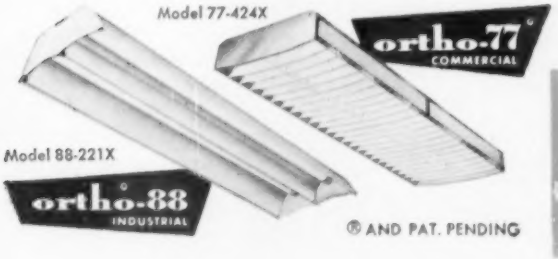
1. WIRED ON THE FLOOR • A special channel (UNI-RACE) of telescoping 4' or 8' sections is assembled and wired on the floor, then lifted as a unit and mounted directly on joists, I-beams or stems. Saves hours of labor.



2. READY FOR THE FIXTURES • The UNI-RACE in place showing the built-in receptacles at 48" intervals. While the building is under construction, it will serve as a source of power for tools and temporary lighting.

3. SNAP—AND IT'S UP! • When the painters have left, the fixtures can be delivered to the building and snapped into place as fast as they are unboxed. Each fixture has a built-in plug which engages the receptacle in the UNI-RACE. Fixtures align themselves automatically.

4. VARIABLE SPACING • Fixtures may be installed in continuous rows or spaced at intervals of 4, 8, 12 or more feet. Units may be added, removed or rearranged any time without tools. Special "fill-in" sections close the UNI-RACE where no fixtures are mounted.



® AND PAT. PENDING

Gibson LIGHTING

GIBSON Manufacturing Co.

1919 Piedmont Circle, N.E., Atlanta 9, Georgia

EASY WAY

TO FINISH A JOB

MULTIMOUNT LUG
SINGLE LUG
TWIN LUG
SPLICER
Socket set screws furnished as standard. Hex head screws available on all fittings at no extra cost. L35 and L70 furnished with slotted screw to allow tightening with screwdriver.
BLACKBURN
L250-2
1/0-250M

BLACKBURN

TERMINAL LUGS AND SPLICERS

- Quickly Installed—No Special Tools Required
- Highest Quality Materials Throughout
- Rugged, Durable Construction; Compact Design
- Choice of Bolt—Screw, Socket or Hex-head
- Economically Priced

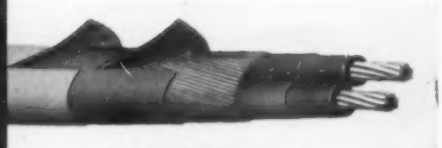
Available Through Electrical Wholesalers Everywhere
Write for Latest Lug Bulletin Containing Specifications and Prices

JASPER BLACKBURN CORPORATION

35 MADISON STREET • ST. LOUIS • MAIN 1-2821

MORE POWER to run all the appliances homeowners want is assured by installation of Anaconda Silvaline Type SE Service Entrance Cables. ▸

The cable that helps to break a bottleneck



Silvaline is the only Type SE Cable with URC saturant and finish.

With skimpy outside cable, no amount of inside wiring can give your clients the power they want. But here's good news . . .

Anaconda's new Silvaline* Type SE Cables, with 100-Amp rating or more, enable contractors to surpass the new NAHB Voluntary Adequate Wiring Code calling for 100-amp service entrance.

Eliminates Complaints. Silver finish on Silvaline takes any type or color of house paint. Does not become sticky, won't flake or peel . . . will not mark walls.

Direct to Range. Silvaline can be installed from pole to house to meter in *one run* and then to range. No conduit required. Fully approved. Saves time and money.

Long Service Life. Silvaline is the only service entrance cable with URC† saturant and finish.

Available from your Anaconda distributor. Write for descriptive folder on Silvaline Type SE Cables to: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U. S. Pat. Office
†Utilities Research Commission

56556C

SILVALINE TYPE SE CABLES — 100-AMP RATING OR MORE

Conductors	Insulation	Rating (in amps)
3/C #3 with #3 or #5 neutral	Type RH	100
3/C #2 with #2 or #4 neutral	Type RH	115
3/C #1 with #1 or #2 neutral	Type RH	130
3/C #0 with #0 or #1 neutral	Type RH	150

ASK THE MAN FROM ANACONDA®

FOR SILVALINE TYPE SE-100 SERVICE ENTRANCE CABLE

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

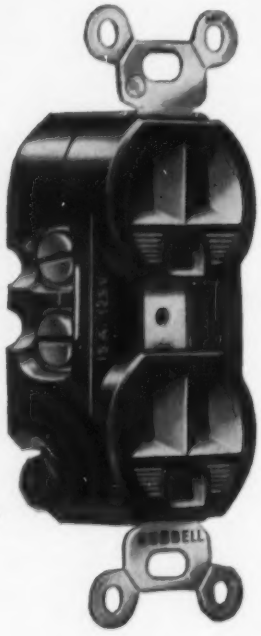
NEW 3-WIRE, GROUNDING-TYPE CONVENIENCE OUTLET

with rugged, two-piece construction

CAT. NO.
5252
15 Amperes
125 Volts

POLARIZED

Two green hexagonal grounding screws, one per side, permit wiring flexibility.



Designed for the Purpose . . .
For Grounding Exposed Metal Parts of Portable Electrical Equipment

A competitive, yet highly dependable, duplex, flush-mounting receptacle for all practical applications. Unit is side-wired with grounding terminals and with parallel slots. Available in brown bakelite, #5252, and in ivorine, #5252-I.

15 AMPERES
125 VOLTS

FEATURES

- Large head binding screws
- Break-off feature for two-circuit installations
- Two green hexagonal grounding screws — one per side.
- Will accommodate two armored or rubber caps
- Slots for 2-wire regular and polarized caps
- U-shaped slot for ground blade
- Rugged 2-piece bakelite construction.
- Washer-type plaster ears and wire looping slot.

Can be used with metallic or non-metallic wiring systems.

Designed with two current carrying contacts and one grounding contact.

Grounding contacts electrically connected to supporting bridge and to the two hexagonal-shaped green finished binding screws, located one on each side of the unit.

Grounding of metallic system wiring is directly through metal enclosure.

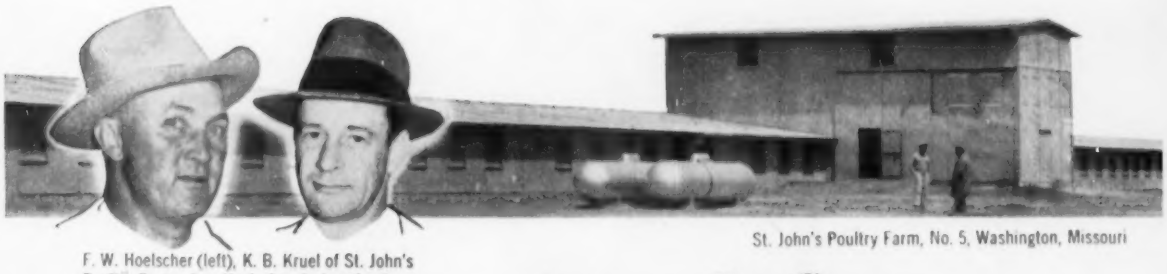
Grounding of non-metallic systems is through a third wire acting as a grounding conductor.

Harvey Hubbell, INC.

DEPT. C-1 **Bridgeport, Conn.**

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

State and Bostwick Sts. Bridgeport 2, Conn. | 37 South Sangamon St. Chicago 7, Ill. | 103 North Santa Fe Ave. Los Angeles 13, Calif. | 1675 Hudson Ave. San Francisco, Calif. | 9111 Dragon St. Dallas 7, Texas

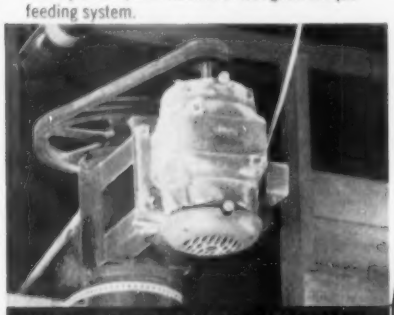


F. W. Hoelscher (left), K. B. Kruel of St. John's Poultry Farms, Inc. Hoelscher designed unique feeding system.

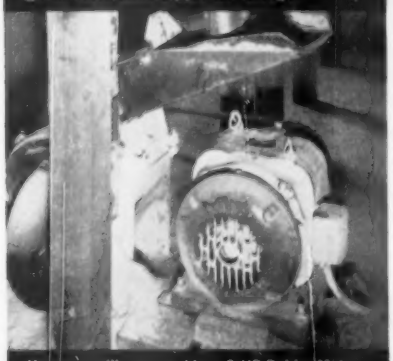
St. John's Poultry Farm, No. 5, Washington, Missouri

Baldor

STREAMCOOLED MOTORS help feed 120,000 chickens Automatically!



Vertically-mounted, 2-HP Baldor Motor drives screw elevator which lifts corn grain from ground level into hopper for storage.



Hammer mill, powered by a 5-HP Baldor Motor, grinds grain and blows it to weighing bin and mixer.

Special feed is mixed with ground corn. Vertically-mounted, 3-HP Baldor Motor drives mixer. All motors are single phase.

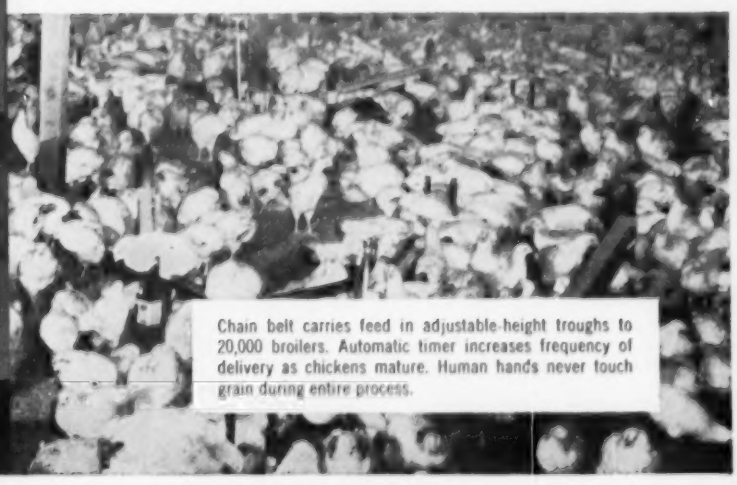
St. John's Poultry Farms, Washington, Mo., boasts one of the most time and labor saving systems for feeding chickens in the world! Six block-and-a-half long broiler buildings house 20,000 chickens each. *One man* maintains each brooder.

Many Baldor Streamcooled Motors power these automatic feeding systems. Splash-proof, dust-proof, totally enclosed motors keep out powder-like grain that constantly fills the air. Non-clogging external fans can't cause trouble that might stop entire system.

This is just one case among thousands where Baldor Streamcooled Motors have been picked for a tough job—a job demanding outstanding ruggedness and dependability. Whatever the installation . . . whatever the application . . . you can recommend and install these field-proven motors with complete confidence—confidence inspired by over a third of a century of service in the electric motor industry.

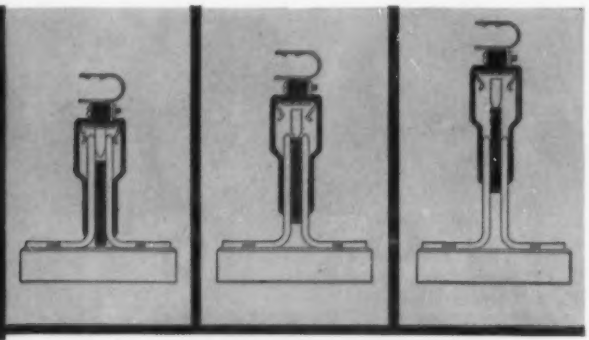
BALDOR ELECTRIC CO.

4353 Duncan Avenue • St. Louis 10, Missouri



Chain belt carries feed in adjustable-height troughs to 20,000 broilers. Automatic timer increases frequency of delivery as chickens mature. Human hands never touch grain during entire process.

The Vacu-Break action is shown by a manually actuated demonstration model of a switch-head. A section of the arc-restricting chamber has been cut away to picture the operation.



1. "ON" POSITION—head has been thrust down on stationary line and load contacts. Contacts engage a self-aligning copper slug, completing circuit and reinforced by the Clampmatic pressure spring to assure a bolt-tight contact.

2. SWITCHING TO "OFF"—head is carried swiftly upward by operating bail, aided by Clampmatic® pressure springs. Arcs are smothered instantly because oxygen and ionizable gas in chamber are restricted.

3. FULL "OFF" POSITION—stationary line and load contacts are completely covered and remain in slots of chamber, assuring positive alignment and maximum safety. Chamber also acts as seal against dust and dirt.

Switch to Vacu-Break Clampmatic

BETTER PRODUCT PERFORMANCE EARNS CLIENT SATISFACTION

BullDog design controls arcing, provides switching security!

Safety, efficiency, economy! Provide these operating advantages—and repeat business builds up. So, for safety switches, bus plugs, power panels and switchboards—you'll find it profitable to turn to BullDog Vacu-Break Clampmatic®.

A trio of design exclusives earn these BullDog products superior performance ratings: (1) Vacu-Break arc control smothers arcs to minimize pitting and burning—thus eliminating maintenance caused by excessive arcing. (2) Clampmatic action provides bolt-tight contact pressure. (3) Dependable switching mechanism guarantees positive switching security.

A switch to Vacu-Break Clampmatic is a switch to greater safety and efficiency for your clients, plus dependable quality and trouble-free installation for you.

Consult your qualified electrical distributor or BullDog field engineer, or write BullDog Electric Products Company, Detroit 32, Michigan. © BEPCO

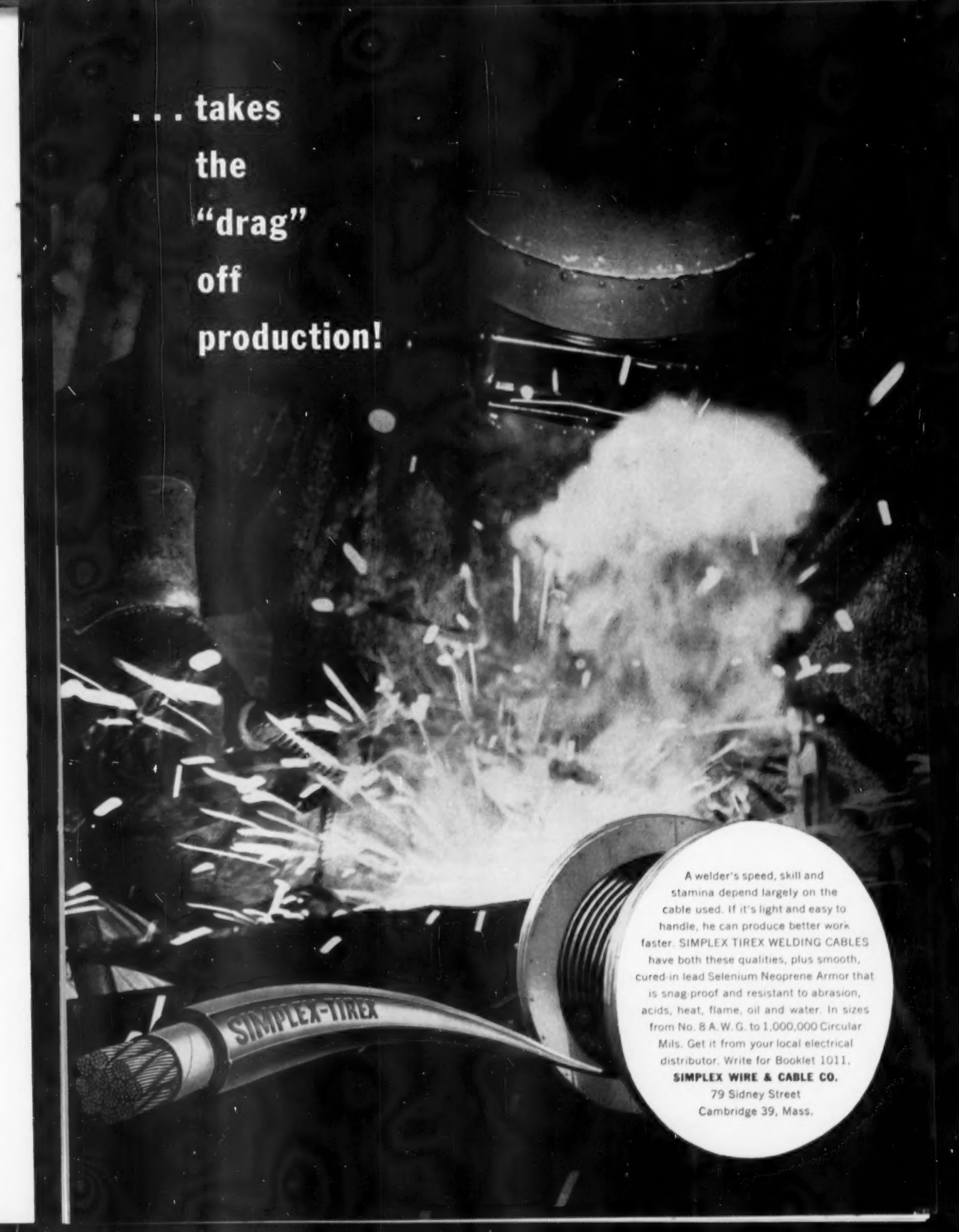
IF IT'S NEW... IF IT'S DIFFERENT... IF IT'S BETTER... IT'S

BULLDOG

ELECTRIC PRODUCTS COMPANY

A Division of I-T-E Circuit Breaker Company

Export Division: 13 East 40th Street, New York 16, N. Y. • *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Road, Toronto 15, Ont.


. . . takes
the
"drag"
off
production!
SIMPLEX-TIREX
A welder's speed, skill and stamina depend largely on the cable used. If it's light and easy to handle, he can produce better work faster. SIMPLEX TIREX WELDING CABLES have both these qualities, plus smooth, cured-in lead Selenium Neoprene Armor that is snag-proof and resistant to abrasion, acids, heat, flame, oil and water. In sizes from No. 8 A.W.G. to 1,000,000 Circular Mils. Get it from your local electrical distributor. Write for Booklet 1011.
SIMPLEX WIRE & CABLE CO.
79 Sidney Street
Cambridge 39, Mass.

Tube-weld

...a new concept in electric fitting design!

Look closely at every detail of this new line..."Tube-Weld". *Its advantages are basic!*

All fittings are precision-made of one piece heavy gauge welded steel tubing which has been accurately drawn and sized for controlled uniformity. These fittings cannot open or spread and far surpass U L requirements.

They are made by Electric Tube Products, a division of Berger Machine Products, with over 36 years manufacturing experience.

Tube-Weld fittings represent an entirely new concept in quality, design and price. *They are available in ½", ¾" and 1" sizes* and have the *following features:*

- Oversized hardened steel set screws are used throughout and are *staked for permanency!*
- Extra long length of offsets provide exceptionally easy pulling of wire.
- Longer length of fitting provides maximum support for conduit.
- Connector shoulders are uniformly flat assuring perfect centering in the box.
- All threads are rolled instead of cut and have 54% greater stripping strength and 66% greater snapping strength (independent testing laboratory report) over cut threads.
- Lustrous zinc finish and carefully beveled edges add a distinctive appearance – allow largest inside working diameters.
- Carefully and smartly packaged for ease in shelving and identification. For descriptive brochure and additional information write or call:

Electric Tube Products

74-16 Grand Ave., Maspeth (N.Y.C.) N.Y.

DEfender 5-8000

CONNECT WITH ETP FOR ECONOMY

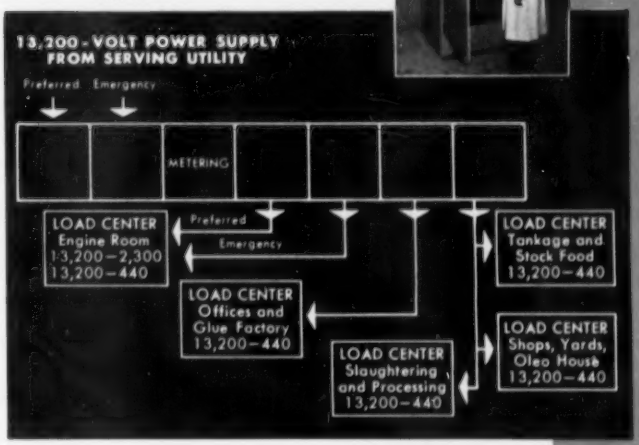
A Division of *Berger Machine Products, Inc.*

WHY PAY DOUBLE FOR METALCLAD SWITCHGEAR TO HANDLE YOUR POWER SUPPLY?

SPECIFY S&C AND

SAVE 50%

Above: Main switching center.
Right: Fred Topinka, Chief Engineer at the primary gear for one of the load centers.


13,200-VOLT POWER SUPPLY FROM SERVING UTILITY
Preferred
Emergency
METERING
LOAD CENTER Engine Room 13,200–2,300 13,200–440
Preferred
Emergency
LOAD CENTER Offices and Glue Factory 13,200–440
LOAD CENTER Slaughtering and Processing 13,200–440
LOAD CENTER Tankage and Stock Food 13,200–440
LOAD CENTER Shops, Yards, Oleo House 13,200–440

Typical high-voltage power supply systems for industrial plants are rarely exposed to faults, either transient or permanent. For that reason they can use the simple radial form of power distribution, and dispense with high-priced protective equipment that provides automatic fault reclosure. Reliable interruption of permanent faults and occasional switching is all that is required; and this is provided by S&C Metalclad Switchgear.

In overhauling the power supply for its Omaha stockyards, Swift & Co. is employing S&C Metalclad Switchgear . . . a 7-unit assembly for the high-voltage switching center, and single units for the primary gear at three of the load centers.

The diagram of Swift & Co.'s high-voltage power supply shows a simple radial system where use of S&C Metalclad Switchgear effects substantial economies while providing all necessary protection and switching.

Specialists in High-Voltage Switchgear for Electric Utilities since 1910

S&C ELECTRIC COMPANY

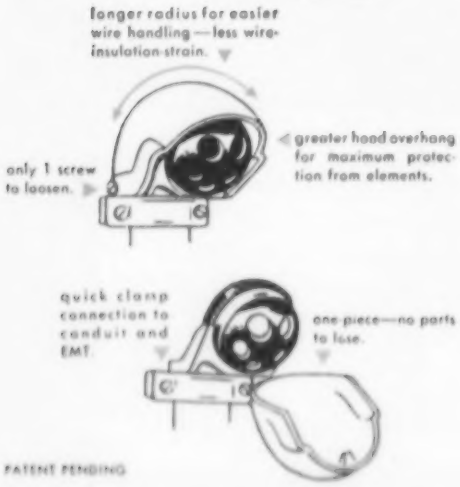
4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U.S.A.

In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario

Consult your telephone directory. Sales offices in Birmingham, Boston, Buffalo, Chicago, St. Louis, Cleveland, Dallas, Dearborn, Denver, Houston, Huntington, Indianapolis, Jersey City, Kansas City, Little Rock, Memphis, Minneapolis, New Orleans, Philadelphia, Pittsburgh, Portland (Ore.), St. Petersburg, Salt Lake City, San Francisco, San Gabriel (Los Angeles), Seattle, Syracuse, Washington, D. C.

new "swing top" entrance cap

with the hood that hangs on a hinge!


longer radius for easier wire handling—less wire-insulation strain.
only 1 screw to loosen.
greater hood overhang for maximum protection from elements.
quick clamp connection to conduit and EMT.
one-piece—no parts to lose.

PATENT PENDING

FOR EASIER, COST-SAVING INSTALLATION

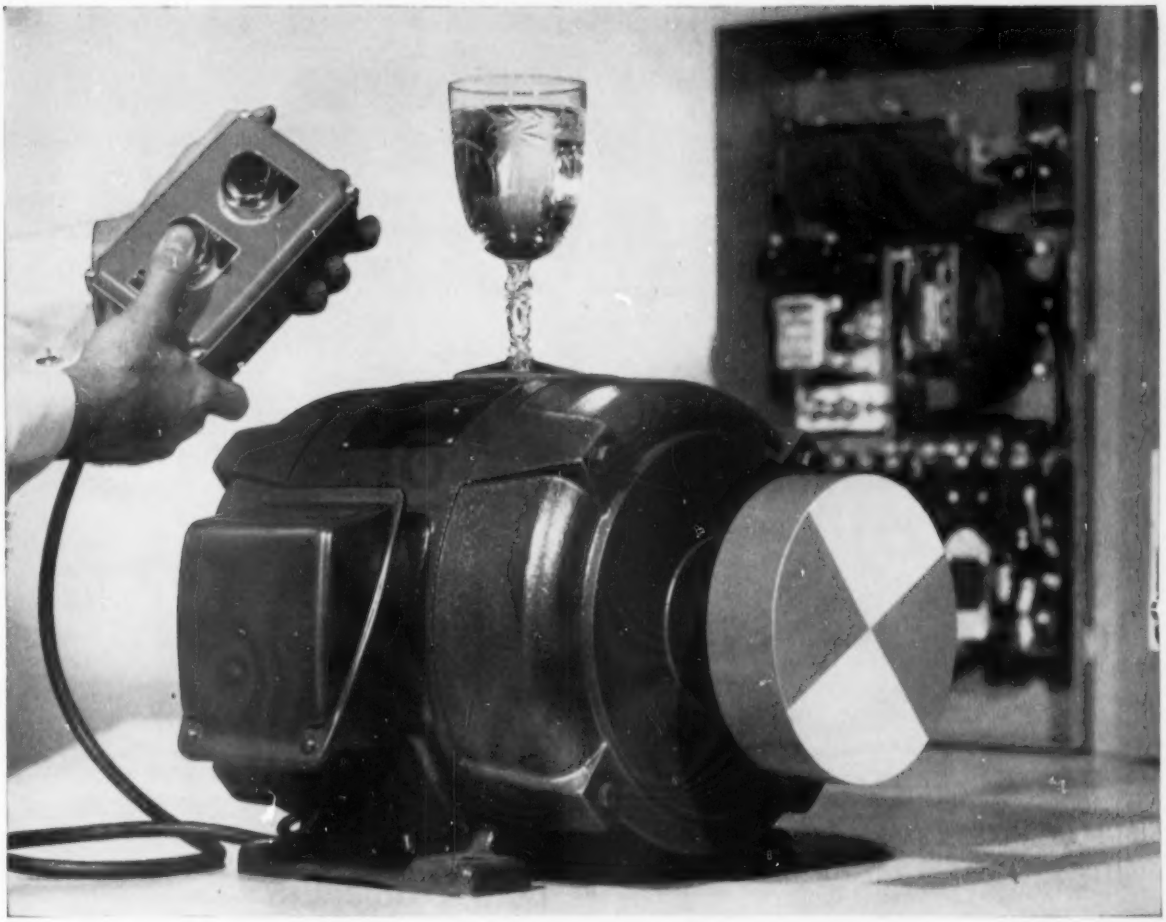
Cut entrance installation time by *two-thirds* with Efcor's new "Swing Top" entrance cap. Loosen one screw, swing the hood open . . . that's all it takes to pull wires through the head! The patented, one-piece hinged construction retains the hood until you're ready to replace it. With conventional units, you're required to loosen several screws, completely remove the cover, put it in your pocket, or on the ladder where it might fall to the ground. "Swing Top" also has a longer radius to facilitate wire pulling and minimize strain on wire insulation. The rugged clamp connector permits quick attachment to conduit *directly against the wall*. No threading, no offsetting needed . . . accommodates EMT too.

WRITE FOR FREE SAMPLE *or see your Electrical Distributor.*

Efcor

electrical fittings corporation

[illegible] STREET • WOODSIDE 77, NEW YORK



New DynAC® stops motors *instantly*...without a ripple!

Here's dramatic proof of the smooth, controlled braking action of the new Westinghouse DYNAC braking controller. Motor stopped *instantly*—without disturbing the water in the glass goblet. "Grabbing" or jerky stops are eliminated with DYNAC braking.

Wherever rapid and/or controlled stopping is required, DYNAC can not only contribute an important safety factor, but it can save you headaches—*and money*—on: (1) production time, (2) material rejects and spoilage, and (3) maintenance expense.

Because it's *completely* electrical, DYNAC requires no mechanical apparatus or motor linkage—it simplifies maintenance. And it comes in *one* compact, spacesaving enclosure. Get the facts on DYNAC's many cost-cutting applications—with every type of standard induction motor. Use the coupon below for more information on DYNAC. J-30200

YOU CAN BE SURE...IF IT'S

Westinghouse

WESTINGHOUSE ELECTRIC CORPORATION
P.O. Box 868, Pittsburgh 30, Pa.

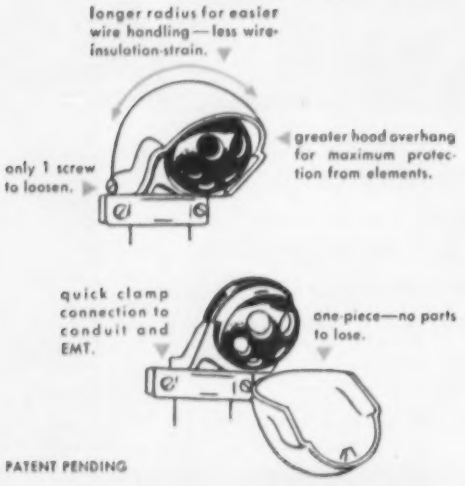
Please send me descriptive bulletins 15-600 and B-6572 on the new DYNAC braking controller.

Name

Company

new "swing top" entrance cap

with the hood that hangs on a hinge!


longer radius for easier wire handling—less wire-insulation strain.
only 1 screw to loosen.
greater hood overhang for maximum protection from elements.
quick clamp connection to conduit and EMT.
one-piece—no parts to lose.

PATENT PENDING

FOR EASIER, COST-SAVING INSTALLATION

● Cut entrance installation time by *two-thirds* with Efcor's new "Swing Top" entrance cap. Loosen one screw, swing the hood open . . . that's all it takes to pull wires through the head! The patented, one-piece hinged construction retains the hood until you're ready to replace it. With conventional units, you're required to loosen several screws, completely remove the cover, put it in your pocket, or on the ladder where it might fall to the ground. "Swing Top" also has a longer radius to facilitate wire pulling and minimize strain on wire insulation. The rugged clamp connector permits quick attachment to conduit *directly against the wall.* No threading, no offsetting needed . . . accommodates EMT too.

WRITE FOR FREE SAMPLE *or see your Electrical Distributor.*

Efcor Reg. Trade Mark

electrical fittings corporation

37-52 57th STREET • WOODSIDE 77, NEW YORK

New DynAC® stops motors *instantly*...without a ripple!

Here's dramatic proof of the smooth, controlled braking action of the new Westinghouse DYNAC braking controller. Motor stopped *instantly*—without disturbing the water in the glass goblet. "Grabbing" or jerky stops are eliminated with DYNAC braking.

Wherever rapid and/or controlled stopping is required, DYNAC can not only contribute an important safety factor, but it can save you headaches—*and money*—on: (1) production time, (2) material rejects and spoilage, and (3) maintenance expense.

Because it's *completely* electrical, DYNAC requires no mechanical apparatus or motor linkage—it simplifies maintenance. And it comes in *one* compact, spacesaving enclosure. Get the facts on DYNAC's many cost-cutting applications—with every type of standard induction motor. Use the coupon below for more information on DYNAC. J-30200

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Westinghouse

WESTINGHOUSE ELECTRIC CORPORATION
P.O. Box 868, Pittsburgh 30, Pa.

Please send me descriptive bulletins 15-600 and B-6572 on the new DYNAC braking controller.

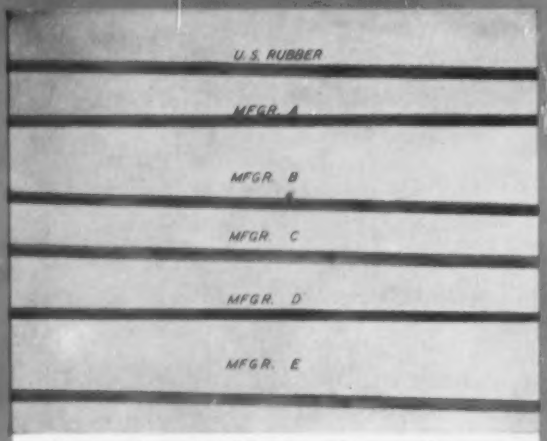
Name_____

Company_____

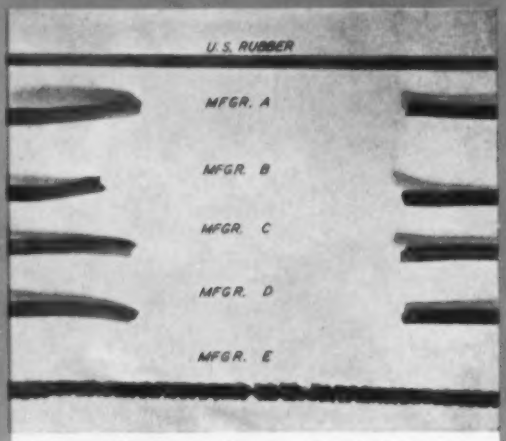
Address_____

City_____ State_____

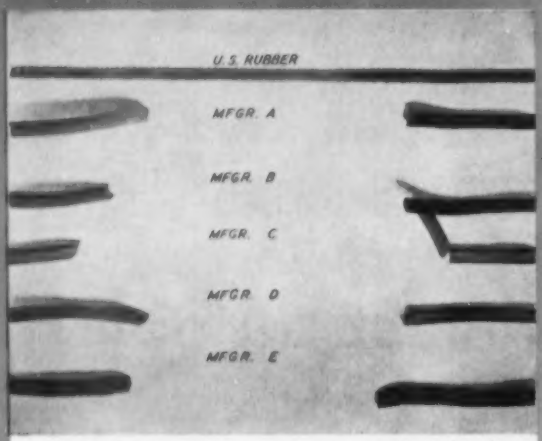
Grizzly High Voltage Power Cables



Here are 6 samples of widely used competitive neoprene jackets (stretched 200% of original length) at start of test for ozone resistance.



2 hours, 23 minutes after start. Brand "E" is disintegrating. Brand "B" has failed 13 minutes ago; the other brands failed an hour or more before.



Taken 7 hours after start of test – Brand "E" failed after 2 hours, 30 minutes. U. S. Grizzly Power Cable's jacket showed practically no sign of damage. It did not fail until after 18 hours of exposure.

Proved far and away the winner in an Ozone test of 6 leading competitive jackets!

U. S. Grizzly® High Voltage Power Cables are unmatched in performance, durability and all-around economy. Order these superior cables from your "U. S." branch, distributor or write Electrical Wire & Cable Department, United States Rubber Company, Rockefeller Center, New York 20, N. Y.

Obsolete wiring can cause power failure, step up expense and push down your production. That's why it's important to make sure your plant is equipped with Adequate Wiring – adequate not only for today's needs but also for the increased electrical loads needed in your future growth.

Electrical Wire & Cable Department

United States Rubber

eliminate guesswork!

The world's most popular snap-around volt-ammeter can be carried everywhere you go, strapped to your belt. It's always ready to reach into hard-to-get-at places, measuring current and voltage accurately without interrupting service. Just snap the jaws around the wire – flick the switch – and measure current without disconnecting any wires.

To save time on every job – use a pocket-size Amprobe. It's so easy to carry.

Get the complete hours-and-dollars-saving story as told in Amprobe service bulletins. Mail coupon today.

AMPROBE a division of Pyramid Instrument Corp., Lynbrook, N. Y.
world's most popular snap-around volt-ammeter

One million Amprobes in use today make Amprobe the standard snap-around tester of the industry. There's an Amprobe for every job, every budget: from 10 amp and 250 volts to 1200 amp and 600 volts AC; from $19.85 to $67.50.

MAIL FOR FREE SERVICE BOOKLETS

Pyramid Instrument Corp., Dept. M-66, Lynbrook, N. Y.
Please send me the Amprobe service bulletins checked below.

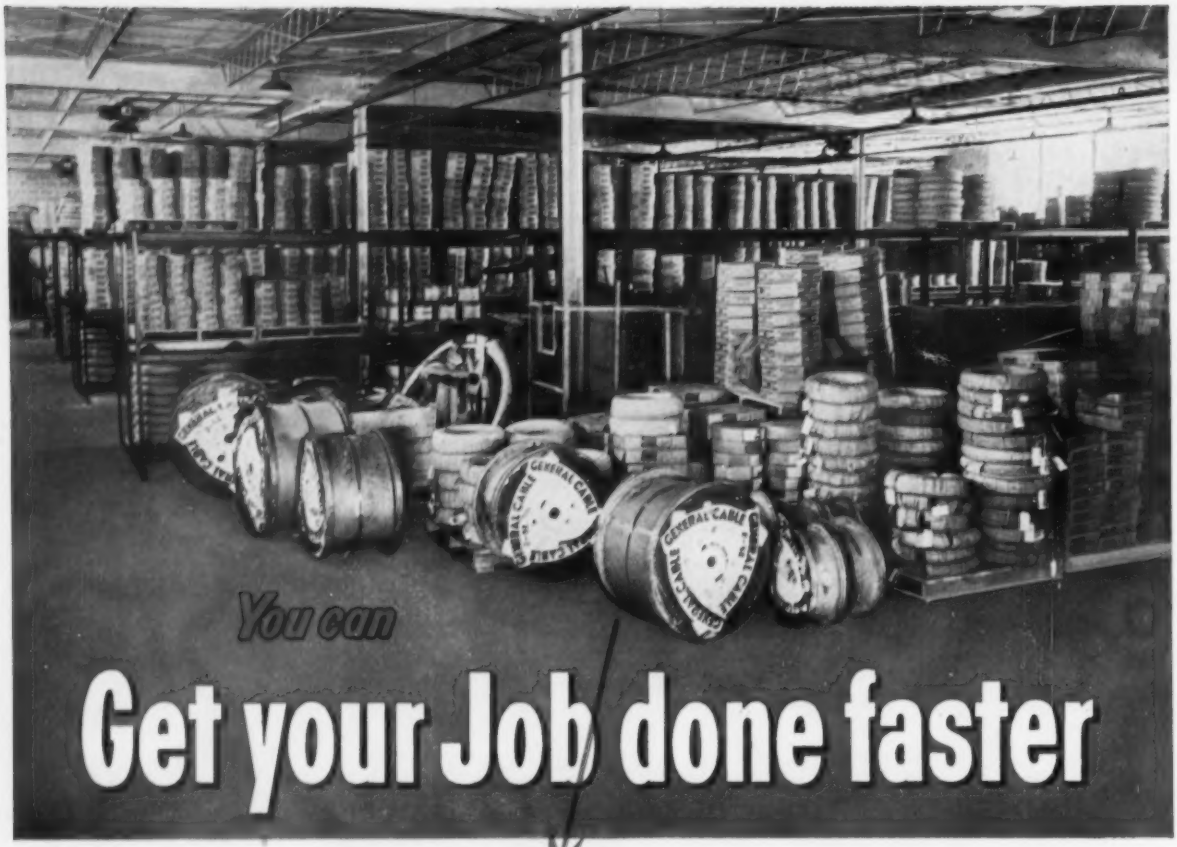
- ☐ How to cut costs and land more jobs
- ☐ How to boost your service profits
- ☐ Trouble-shooting electric motors
- ☐ Electrical serving of hermetic units

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____



Backing up ***the stocks carried by your AUTHORIZED GENERAL CABLE DISTRIBUTOR are large stocks at a nearby GENERAL CABLE Distributing Center.***

The result . . . everything you need is readily and quickly available. Specify General Cable.

29 "GENERAL" Distributing Centers Coast-to-Coast.

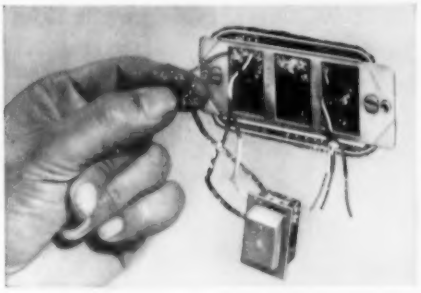
All these stocks in light traffic locations for fast delivery.

General Cable . . . at your service!

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N.Y. Offices and Distribution Centers Coast-to-Coast

G-E Remote-Control Wiring is easy to install . . .

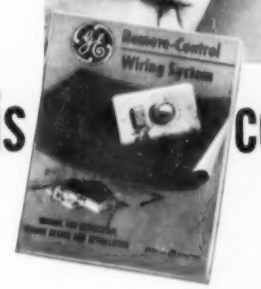
REMOTE-CONTROL RELAY.
Controls lights or outlets and is actuated by the low-voltage current.



COLOR-CODED LEADS
make connection identification and installation of switches quick and easy.

LIGHTWEIGHT WIRE.
Used to wire the switches. Can be stapled to framing.

HARMONIZING WALL PLATE
completes the flush-switch installation.

once you've read this  contractors' manual

More and more home builders are asking electrical contractors about the G-E Remote-Control Wiring System. Right now is the time for you to get ready to answer their questions by sending today for the 36-page manual that describes fully and clearly how the G-E Remote-Control Wiring System works. It contains diagrams that will help you explain the many modern features and conveniences of G-E Remote Control. And it also shows you how to lay out, estimate, and install this modern system, with valuable wire-saving and time-saving ideas that keep installation costs to the minimum.

Trouble-free Performance

General Electric, with nearly 10 years of field experience in remote-control wiring, has designed and improved the components to meet new standards of trouble-free performance. The remote-control switches, for example, now have a heavier spring contact, reinforced mounting bracket, and redesigned switch action for smoother operation and longer life. The new long-life remote-control relay has a nylon core, more positive switching action, heavier contact supports, and new riveted construction.

Send today for the "G-E Remote-Control Wiring Manual". Take advantage of the opportunities for "plus" business and good will that G-E Remote-Control Wiring offers the electrical contractor. Wiring Device Department, General Electric Co., Providence 7, R. I.

Progress Is Our Most Important Product

GENERAL ELECTRIC

GENERAL ELECTRIC ANNOUNCES . . .
NEW Industrial
GENERAL ELECTRIC
DIRECT CURRENT MOTOR

Direct-current Motor

KINAMATIC* a new standard in direct-current motors, gives your machines wider speed ranges, greater output

To meet modern industrial needs for faster, more automatic, more continuous production, General Electric has designed an entirely new direct-current motor—the d-c Kinamatic.

Designed for Automation—Now, a direct-current motor has been designed for the modern job it has to do—either as individual motor drive or in regulating systems. The new General Electric d-c Kinamatic motor supplies the wide speed range and versatility required for today's manufacturing methods. It is designed for the close control of machines and split-second timing of processes essential to higher output.

Accelerated Production—The new d-c Kinamatic motor will modernize your equipment, give it increased power, higher speeds, greater output capacity. With the quick-acting G-E Kinamatic motor, your machines will process a greater variety of products . . . faster . . . easier . . . and with less maintenance and spoilage.

More Powerful—By combining advanced design with improved materials and manufacturing techniques, General Electric engineers have packed more power into the entire Kinamatic line. The powerful Kinamatic motor, with new stamina and durability, is ready to become one of your most effective weapons for keeping costs down, for meeting competition, for boosting productivity levels.

Engineering Help—Industrial specialists in 149 conveniently located General Electric Apparatus Sales Offices have the complete story on how the new d-c Kinamatic motors and generators can benefit your operation. For full details, contact your G-E Sales Representative, or write for Bulletin GEA-6355. *Direct Current Motor and Generator Department, General Electric Company, Erie, Pennsylvania.* 8151

* Trade Mark of the General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

General Electric

ANNOUNCES

Brand New BX* Armored Cable

EASIER STRIPPING . . . FASTER WORKING . . . NO BRAID TO TRIM

General Electric's new BX cable with special thermoplastic insulation offers you these outstanding advantages *at no added cost:*

1. **MORE COMPACT CONSTRUCTION,** because the elimination of braid reduces the diameter of singles (works easier in cramped areas . . . takes less space in box).

2. **FAST CONNECTIONS,** because identifying color goes right through the insulation . . . eliminates circuit guesswork today, tomorrow or ten years from now.

3. **EASY STRIPPING,** new thermoplastic insulation on singles strips easy and fast . . . no time wasted trimming braid.

4. **CLEAN WORKING,** with no annoying "flake-off" to soil hands or walls.

5. **DEPENDABILITY,** because the thermoplastic insulation resists water, acids, oils, alkalies, aging and combustion. Stands up under twisting, pulling, abrasion.

6. **LOW ARMOR RESISTANCE,** assured by continuous bond strip on *all* sizes.

7. **LISTED BY UNDERWRITERS' LABORATORIES, INC.**

This new General Electric BX cable can help make your jobs go in faster and stay in longer. Prove it on your next installation. For complete information, see your General Electric Construction Materials distributor, or write Section W187-618, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-mark General Electric Company.

Progress Is Our Most Important Product

GENERAL ELECTRIC

WITH GENERAL ELECTRIC CAPACITORS

You can cut power costs by raising power factor at the load

✓ CHECK THESE QUESTIONS TO FIND IF YOU NEED CAPACITORS:

Do you use induction motors, welders, induction heaters or other inductive devices that may reduce your power factor below 95%? ☐

Does your power contract include a power-factor penalty or KVA demand charge because your power factor is low? ☐

Is low power factor overloading your electric system, cutting machine output or blocking increased production? ☐

Do you suffer from low or fluctuating voltage because of heavy kilovar demands? ☐

If the answer is "yes" to any of these questions, G-E capacitors may effect important improvements in your plant operation as well as substantial savings on your power bills.

Poor power factor costs you money . . . money that can be saved by installing economical G-E capacitors. In almost every plant using electric motors, welders, induction heaters or other inductive electric equipment, poor power factor is an expensive, unwanted guest. It's the basis for the penalty clause that appears in the power bills of many electric power companies. And it's often the reason for overloaded power circuits, poor voltage and other plant electrical troubles.

General Electric capacitors supply magnetizing current (or kilovars) required by motors and other inductive equipment—right in your own plant. They relieve power circuits of the added burden of carrying this unproductive current. They can reduce your power bills. Once installed, they go on saving for you year after year.

Sounds too good to be true? It isn't! Many industrial plants find that power savings from G-E capacitors run into thousands of dollars a year. It will pay you to get the full story of raising power factor with capacitors. Just write for Bulletin GEA-5632, "How to Use Capacitors," to the General Electric Company, Section 441-112, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

MODERN 4-story office building and 2-story printing plant has 9200-kva connected load. Present demand is not half that, allowing for secondary switching and growth. 10,000-kva substation capacity, liberally sized feeders also provide for growth.

480Y/277-V General Electric distribution

PLANNING TEAM included (L-R) Frank Sulzbach, Cates & Shepard, electrical contractors; George Rantanen, Turner Const. Co., general contractors; Keith Howe, Pennell & Wiltberger, consulting engineers; Pat Grant of *The Bulletin;* Glenn Taft, G-E application engineer; Dick Powers of *The Bulletin;* and Bill Kurlish of General Electric.

Modern newspaper plant proves economies of higher-voltage system in combination office and production building

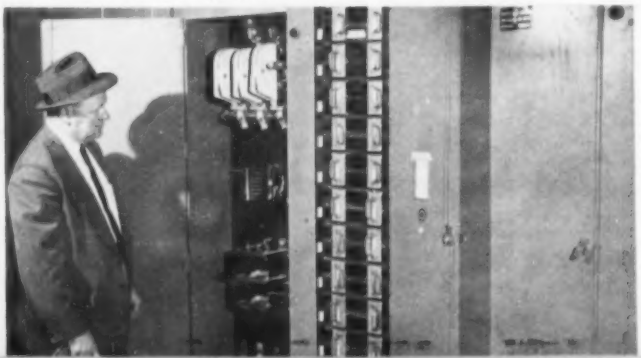
Based on cost studies made of similar applications, the *Philadelphia Bulletin* estimates the power distribution system of its new facilities could have cost 25% more if a combined light and power system had not been used.

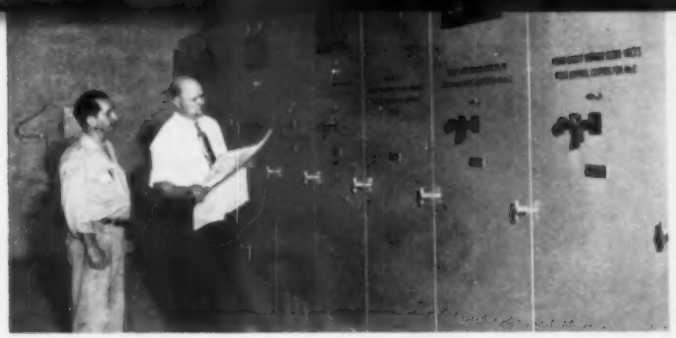
LOAD MAKE UP was 5200 kw for press motors, 1300 kw for metal heating, 1100 kw for lighting, 1600 kw for miscellaneous needs. Since most lighting was suited for 277-v operation and most motors and stereotype furnaces operate at 480 volts, a combined system was an economical choice.

Providing an equivalent system with separate lower-voltage service for lighting would have meant other substations, more

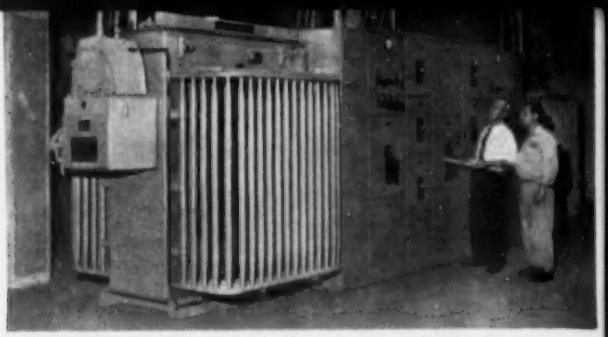
277-V LIGHTING permits use of combined light-power system. G-E 265-v ballasts and standard fluorescent lamps supply 40 footcandles in offices and 75 in composing room.

SAFER, more reliable control and protection of stereo furnace circuits results from use of accurately tested and rated General Electric, metal-enclosed, fused panelboards with current-limiting CLF fuses.

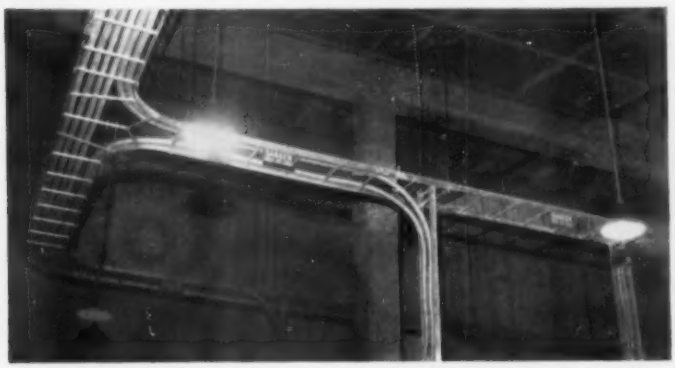




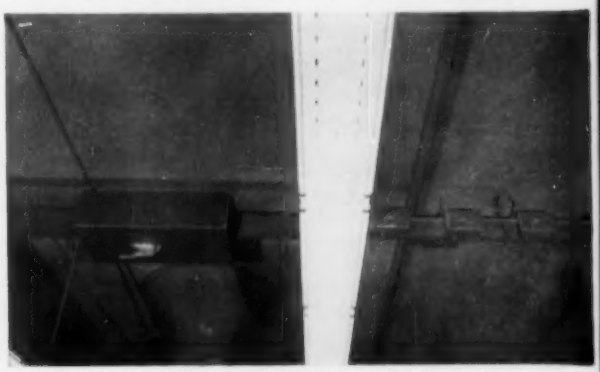
VITAL RELIABILITY of service is provided by G-E metal-clad switchgear protecting dual 13.8-kv service entrance. In emergency either utility feeder can serve the entire building load. Units feature magne-blast breakers.



POWER CONTINUITY is provided by 5 double-ended, load-center substations. Secondary-selective system allows either transformer to serve full load if other is cut out.



FLEXIBLE G-E interlocked armor cable carries power to load areas. It costs less to install, is smaller, more accessible than cable in conduit.



PLUG-IN busway allows flexibility of equipment layout. Outlets every foot make it easy to relocate machines.

system permits big savings at Phila. Bulletin

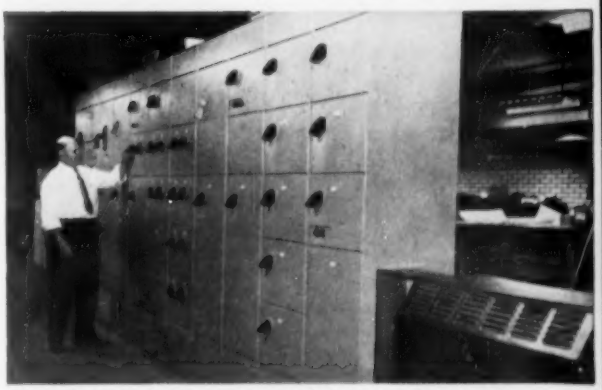
and larger conductors and switching equipment, and much higher first costs. Use of the G-E equipped higher-voltage system allowed large savings in copper and most efficient system layout with interchangeable equipment throughout.

TOP RELIABILITY was required as nothing is so perishable as the news. To help assure power when needed, dual primaries were combined with secondary-selective circuits and highest quality General Electric equipment.

WIDE EXPERIENCE of G-E engineers was made available to system planners and builders. This same service is available to you. Contact your nearest G-E Apparatus Sales Office early in your next project. General Electric Co., Schenectady 5, N. Y.

Engineered Electrical Systems for Commercial Buildings

GENERAL ELECTRIC



CENTRALIZED, factory-engineered G-E motor control center provides convenient, co-ordinated control of auxiliary press motors and 120-volt incandescent lighting.

HIGHLY DEPENDABLE protection of branch circuits and source of needed 120-v power is provided by G-E circuit breakers and dry-type transformers on each floor.

SEND FOR MORE DETAILS ON 480Y/277-V SYSTEM

GENERAL ELECTRIC CO.
SECTION A680-4
SCHENECTADY 5, N. Y.

☐ Please send "Modern 480Y/277-V Power Distribution Planning Guide."
☐ Please send "Modern Distribution Equipment for Commercial Buildings."
I am also interested in ☐ borrowing, ☐ purchasing the new MPA Commercial Building Power Distribution Film Program, featuring the movie, "The Tenant at 1010 Main."

NAME .....

COMPANY ..... POSITION .....

ADDRESS .....

CITY ..... STATE .....

100-AMP CAPACITY of new square socket makes it the "perfect partner" for use with extended range meters such as General Electric's I-55.

VERTICAL OR HORIZONTAL MOUNTING, plus easy addition of a fifth or sixth terminal, illustrates greater versatility.

ADVANCED DESIGN of socket and terminal, plus more wiring space, assures easy installation of 100-amp wire.

General Electric Announces . . .

NEW, EASY-TO-WIRE METER SOCKET FOR 100-AMP INSTALLATIONS

General Electric's new extended range square socket has been designed for meter installations requiring 100-amp capacity. The new, low-cost Type S-1 square socket combines extended range capacity with these important benefits:

EASY INSTALLATION of 100-amp capacity wire (up to # 0 gauge aluminum) is assured by greatly increased wiring space. Location of lay-in type terminals requires a wiring bend of only 45°.

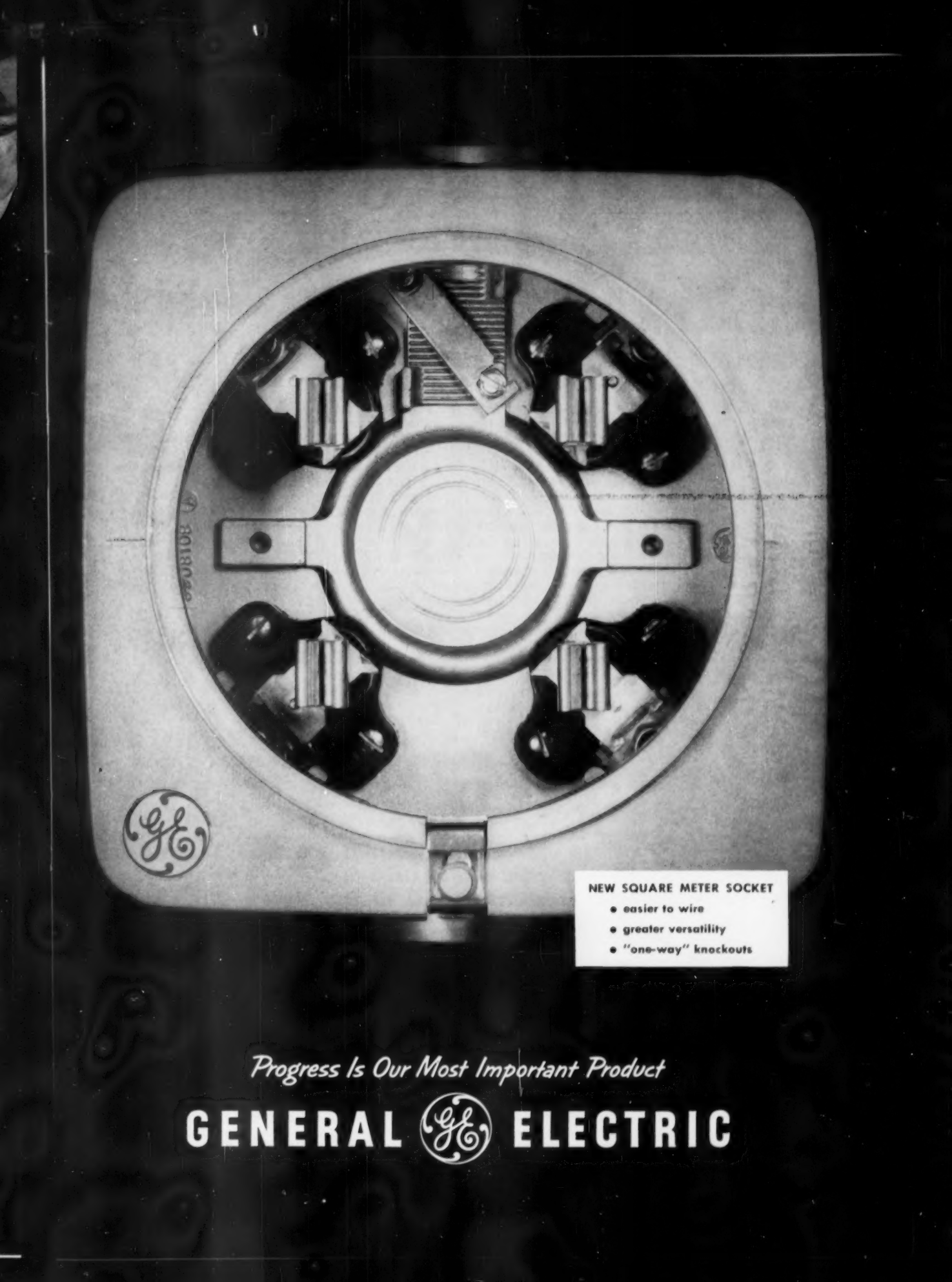
EXCELLENT CORROSION RESISTANCE is provided by die-cast aluminum construction plus baked Glyptal* aluminum finish. Positive, one-way knockouts eliminate any need for prying or bending; unique pre-scoring gives you the exact knockout desired.

QUICK AND EASY ACCESS to the interior is assured by the simple snap-locking device on the socket cover . . . makes removal possible without use of screws or tools.

GREATER VERSATILITY of the new square socket permits either vertical or horizontal mounting simply by interchanging the terminals 90°. Added flexibility may be obtained by the easy addition of a fifth or sixth terminal.

FOR MORE INFORMATION contact your nearest G-E Apparatus sales representative or Authorized G-E Distributor . . . or write for bulletin GEC-1376 to General Electric Company, 625-1, Schenectady 5, New York.

*Reg. trademark of General Electric Co.



Progress Is Our Most Important Product

GENERAL ELECTRIC

THE GENERAL ELECTRIC TSA-40

NEW TIME SWITCH—NEW LOW PRICE

Replacing Type T-27

TSA-40, an entirely new heavy-duty general purpose time switch, has been designed by General Electric to meet your demands for more reliable on-off operation at a lower price.

MANY NEW FEATURES make the TSA-40 a superior time switch for all heavy-duty, on-off applications. Exclusive contact shearing action gives you reliability and long life; new case, latch and cover gasket give complete weather-proofing; smaller size and more wiring space cut installation and maintenance costs; and extended operating temperature limits provide dependable service under a wide range of ambient conditions.

VERSATILE IN APPLICATION, the TSA-40 offers precise and reliable control of all types of street, sign, store window and floor lighting; capacitor switching; heating, air conditioning, and refrigeration; irrigation and pump control; and many other industrial and central station uses. The TSA-40 is fully suitable for both indoor and outdoor applications.

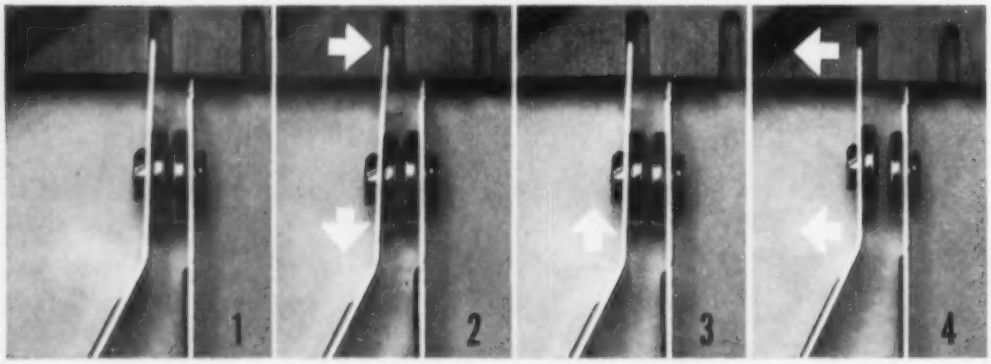
YOU GET EXTRA VERSATILITY when you order a TSA-40 with either or both of these optional features. The *omitting device* permits the TSA-40 to omit its operation on any day or days of the week. It can be added to a standard switch that is already installed. The *astronomic dial* is a special time dial which follows the changing schedule of sunset and sunrise in a particular locality. You save on cost of servicing because the need for regulating the time switch as the days grow longer or shorter is eliminated.

FOR PRICES AND FURTHER INFORMATION, call your nearest General Electric Apparatus Sales Office or write for Bulletin GEA-6468 to Section 584-4, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

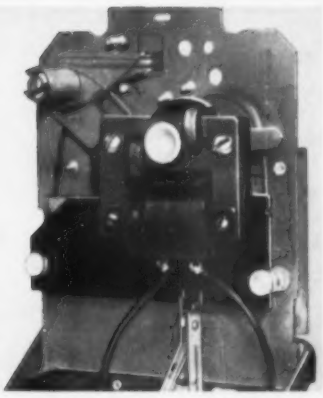
EXCLUSIVE CONTACT SHEARING ACTION GIVES GREATER RELIABILITY



WELDS ARE BROKEN, CONTACTS KEPT CLEAN BY THIS SHEARING ACTION:
(1) Contacts, shown here in closed position, are actuated by slotted bar at top of these actual photographs. At start of opening action (2), bar moves to right forcing left contact to move down with shearing action. As bar completes motion to right (3) contacts are released and spring blades cause second shearing action just before contacts snap open (4). Bar returns to first position ready for next operation.

NO WIRING BURNOUTS or "hot spots" because one-piece contact and terminal eliminate all internal wiring to contacts. Unit terminal block makes replacement easy.

ACTUAL SIZE



GREATER TEMPERATURE RANGE of —50 F to 150 F is made possible by silicone grease in reliable Telechron* motor. Direct drive of switching mechanism assures positive action.

COMPLETELY WEATHERPROOF steel case has press-fit latch for tight seal and easy opening. Side-hinged removable cover simplifies installation and maintenance.

*Reg. trademark General Electric Co.

ADV.

Introducing "Skimpy Wiring" to your homeowner customers!

More than 15,793,000 readers of the Saturday Evening Post and This Week national magazines will see this dramatic Kennecott ad featuring "Skimpy Wiring"—Dead End Kid of the electrical business!

It's another nation-wide advertisement in the Kennecott campaign for better home wiring with copper—a drive that *helps you get more re-wiring jobs!*

Let Kennecott help you with your own local better wiring campaign, too!

SEND FOR FREE PROMOTION MATERIAL

Send today for free reprints and poster-sized blow-ups of *Kennecott's* full-page national advertisements. Get free copies of the educational booklet, "The ABC of Home Wiring." Ask for complimentary home wiring Wall Chart, mat service folder and list of *at-cost* prices for large-quantity orders of all material available. No cost, no obligation! Just write: Kennecott Copper Corp., Dept. EC 66, 161 East 42nd St., New York 17, N. Y.

ADV.

MEET SKIMPY WIRING

The Electrical Delinquent found in 35,000,000 homes!

Look at that tangle of plugs and sockets! Note the frayed, weak-looking wiring! That's him, all right – Skimpy Wiring – the villain responsible for the electrical woes of homeowners all over the nation.

Have *you* a toaster that heats slowly? Does *your* TV set twitch when other appliances go on? Do *your* fuses blow or circuit breakers trip too often? If so, beware . . . you are a victim of Skimpy Wiring!

Weak, worn-out home wiring cannot possibly deliver full power to your appliances. It wastes electricity, can cause appliance failure, may even be a source of fire!

If you see signs of Skimpy Wiring in your own home, call an electrical contractor or consult your local power company. Learn how easily you can have safe, *adequate copper* wiring installed to make your home more *electrically livable!*

* * *

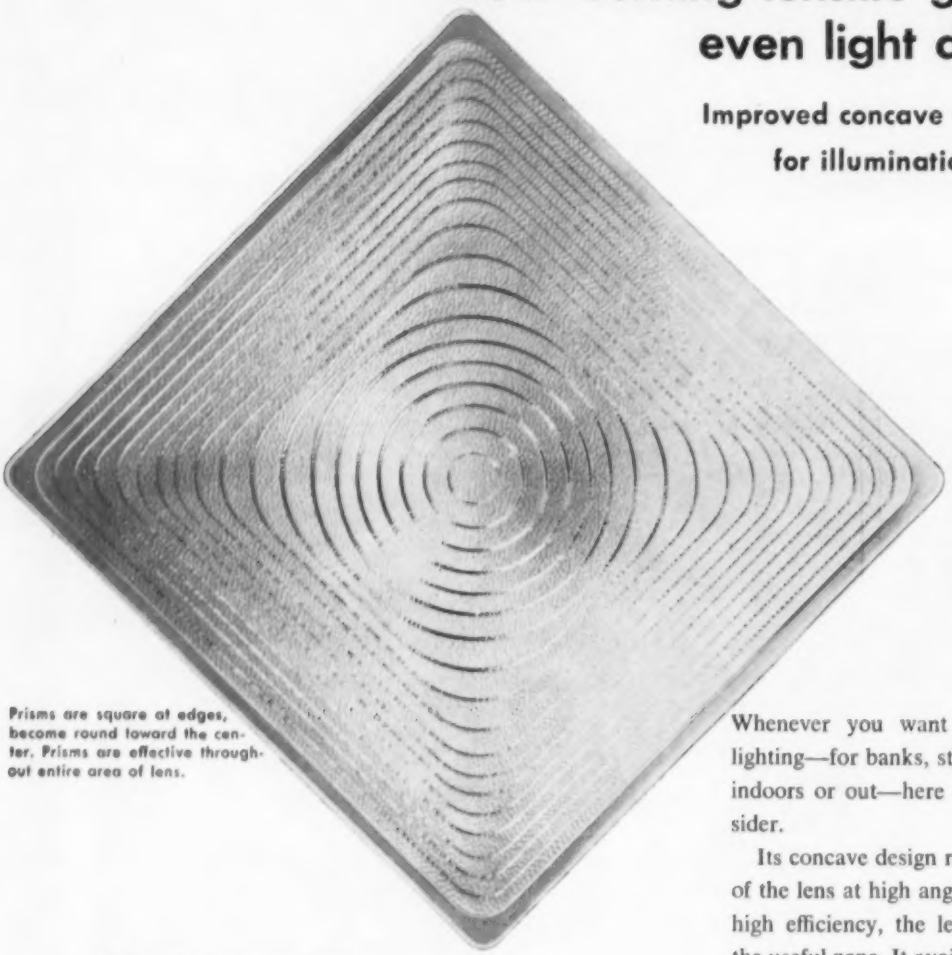
Get FREE Booklet! "The ABC of Home Wiring" explains facts about your electricity, how you can make it serve you better. Write Kennecott Copper Corp., Dept. S46, Box 238, New York 46, N. Y.

Kennecott Copper Corporation

Fabricating Subsidiaries: CHASE BRASS & COPPER CO. • KENNECOTT WIRE & CABLE CO.

New Corning lenslite gives more even light distribution

Improved concave prismatic design for illumination without glare



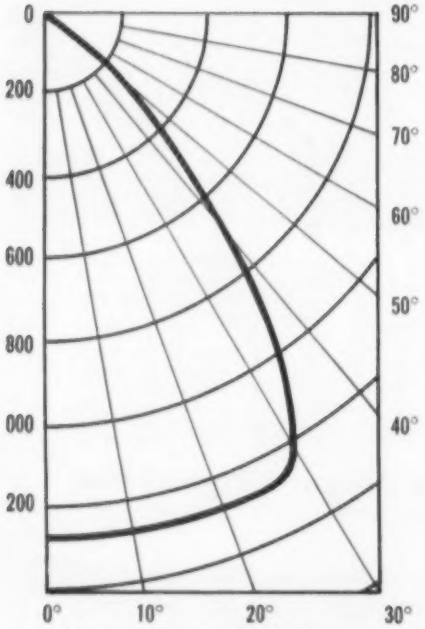
Prisms are square at edges, become round toward the center. Prisms are effective throughout entire area of lens.

Whenever you want to use incandescent lighting—for banks, stores, assembly halls—indoors or out—here is a new lens to consider.

Its concave design reduces the visible area of the lens at high angles. With an unusually high efficiency, the lens gets more light to the useful zone. It avoids sharp angled beams of intense light. It gives illumination without glare.

Because it is made of a heat-resistant glass, you can use the new Corning lenslite indoors or out without fear of thermal shock.

For more information on this new development in Corning Engineered Lightingware write, wire or phone us.

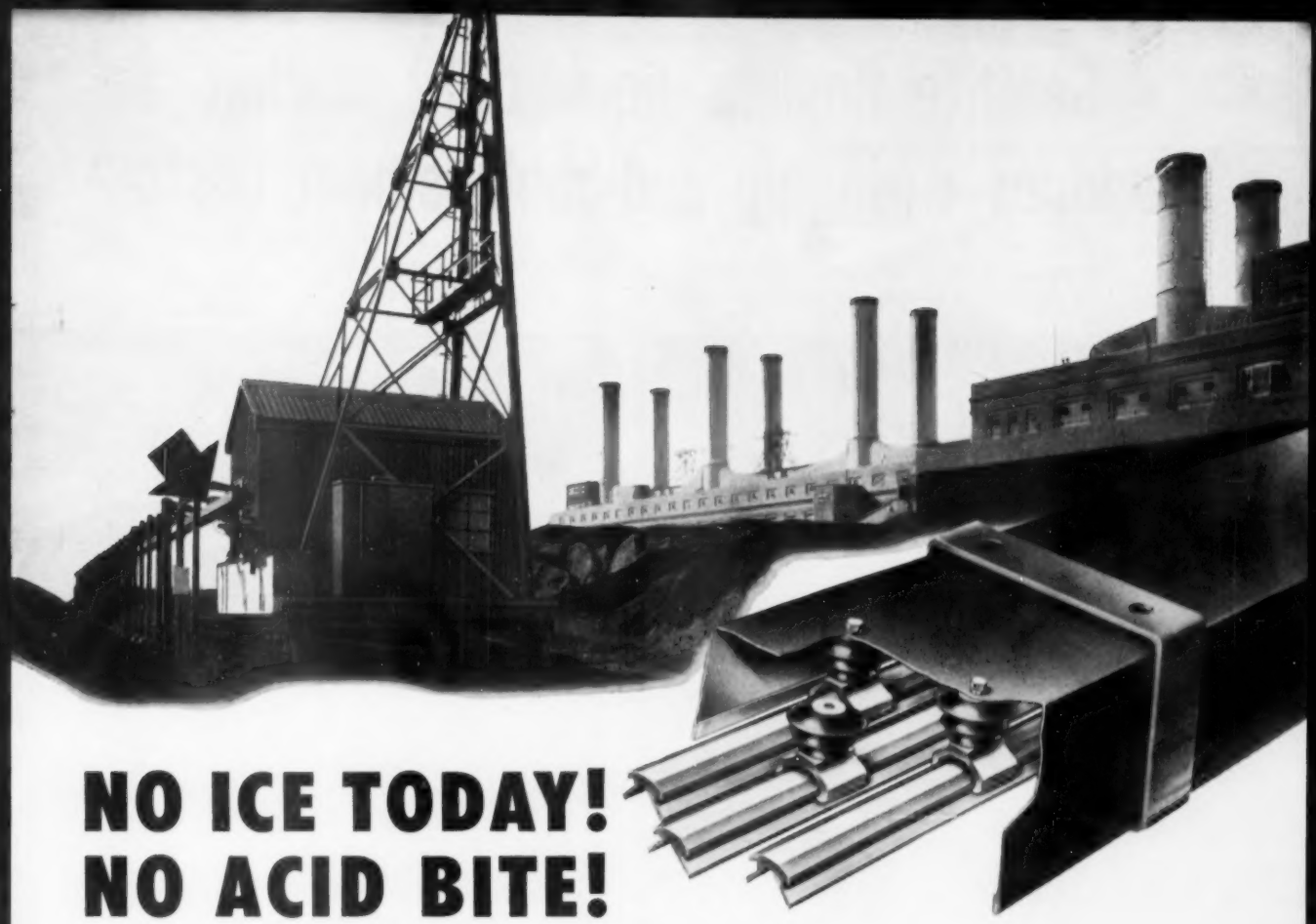


See the uniform light distribution you get with the new Corning Lenslite.

This cross-sectional diagram shows the concave shape of the new Corning lens.

CORNING GLASS WORKS
65-6 Crystal Street
CORNING, N. Y.

Corning means research in Glass



NO ICE TODAY!
NO ACID BITE!

Keystone Aluminum Conductor System Brings Trouble-Free Service To Buffalo Plant

NIAGARA MOHAWK POWER COMPANY has ended a second winter without a shutdown of these coal storage towers. Another trouble-free record for KEYSTONE Aluminum Conductor Systems.

Service conditions are severe in the lake city. This outdoor installation formerly had a big ice problem with the original wire system, but ice can't form on the enclosed KEYSTONE inverted-V conductors. Sulphuric acid fumes from the coal piles won't corrode KEYSTONE's Aluminum Conductors, hangers and joint plates.

The KEYSTONE Integrated Aluminum Conductor System has installation advantages too. Lightweight, compact, easy to erect—an ideal system for the enclosure requirements of these leading towers.

Are you building or modernizing a materials handling system? Then you'll be interested in systems of aluminum, copper or steel. We build them *all*. Our engineers will be glad to discuss the proper application for your requirements.

WRITE TODAY FOR CASE HISTORY BOOKLET ON ALUMINUM CONDUCTOR SYSTEM INSTALLATIONS.

KEYSTONE SAVES 3 WAYS

1. **LONGER LIFE** for conductors; aluminum lasts longer in destructive atmospheres. Longer shoe life; contact surfaces stay smoother, cleaner. Longer insulator life; less vibrating weight. No downtime from ice.
2. **LIGHTWEIGHT** aluminum permits pre-assembly of standard units; reduces installation costs and cost of insulators and supporting structures. Permits economical enclosures to safeguard personnel and operations.
3. **HIGH CURRENT CAPACITY**, low voltage drop. No need for boosters, multi-point feeds on long runways. Pre-engineered systems now operating up to 6,000 amp. capacity. Amperage possibilities unlimited.

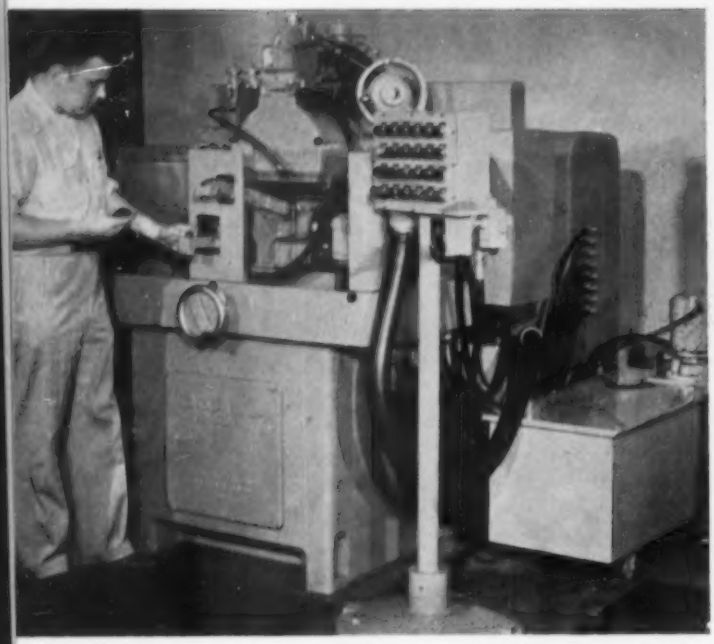
ESM

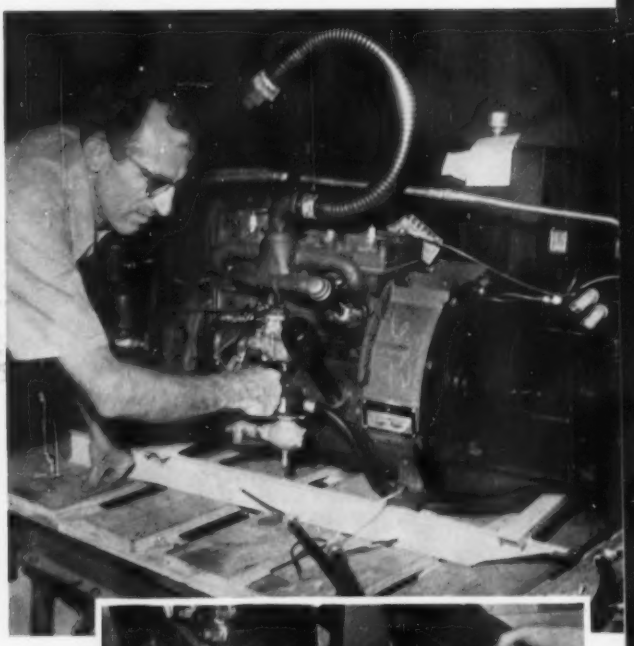
ELECTRIC SERVICE MANUFACTURING CO.

PHILADELPHIA 32, PENNA.

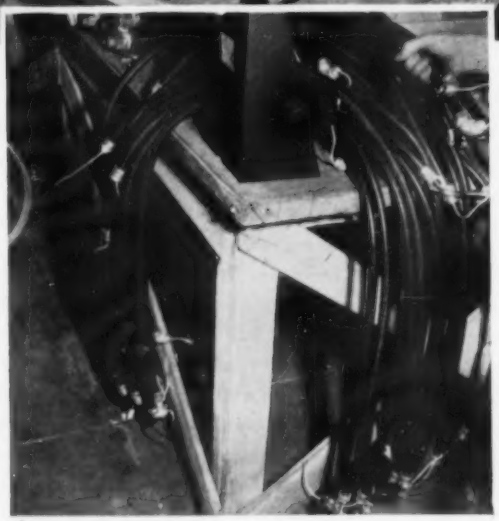
ADVERTISEMENT

Sealtite flexible, liquid-tight conduit *reduces* wiring-up and replacement costs

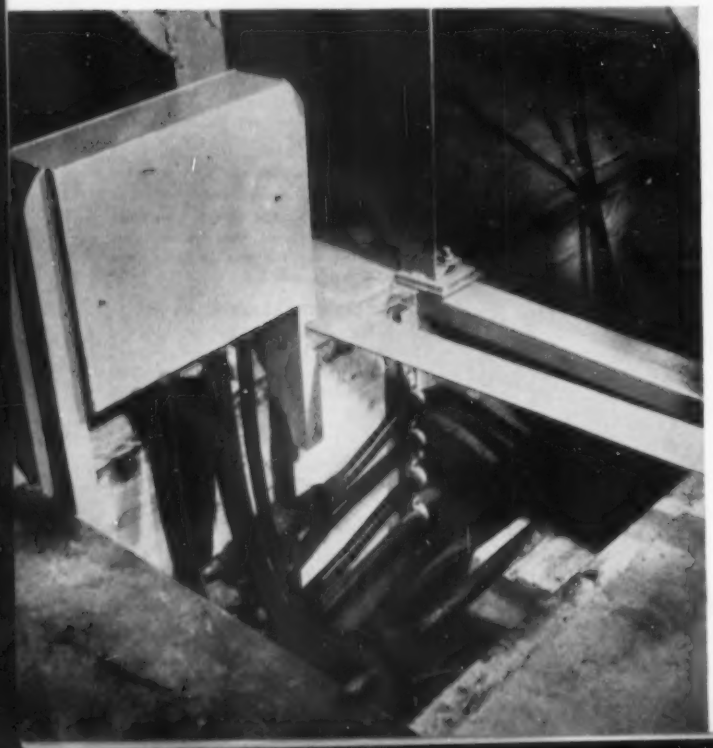




GRINDER DUST and coolant have no effect on tough polyvinyl chloride cover of Sealtite—installed on this DoALL Rotor Grinder used for grinding slots in rotors of power steering and breaking pumps.



COMPOUND BENDS *(top photo)* are easily made on air conditioning equipment manufactured by Cobell Industries, Fort Worth, Texas. *(Lower photo)* Assembly with connectors and wires is easy!



EASILY INSTALLED, Sealtite is used in long lengths to protect wires that actuate hydraulic moving equipment in Howard Smith Paper Mills Ltd., Cornwall, Ontario, Canada. Sealtite withstands oil, chlorine, caustic soda, wet pulp. This conduit protects wiring on the dirtiest jobs around the plant.

ADVERTISEMENT

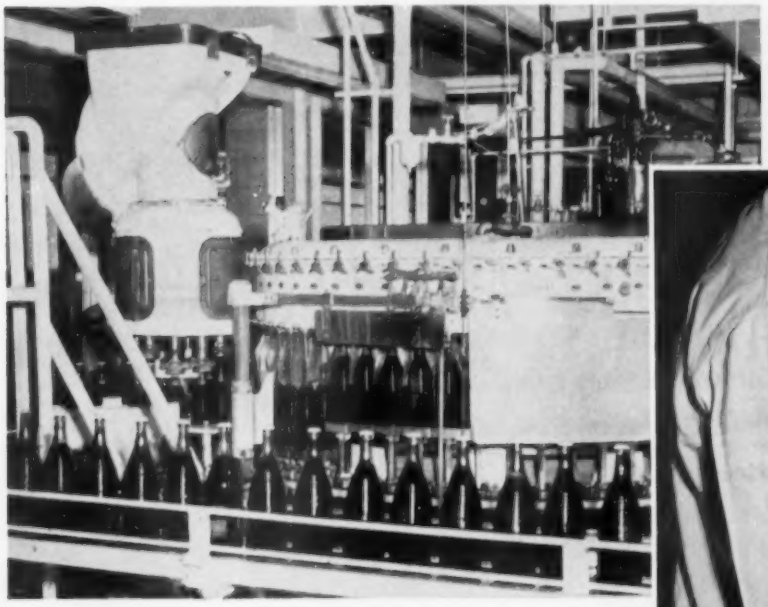
Its PVC jacket shrugs off oil, grease, water, dirt, corrosive fumes, chemicals . . .

Sealtite* is a flexible *and* liquid-tight electrical conduit. It gives maximum protection to your wiring when it must connect moving parts, absorb vibration, follow machine contours, flex into U-bends, be easily maintained or be safeguarded between misaligned outlets.

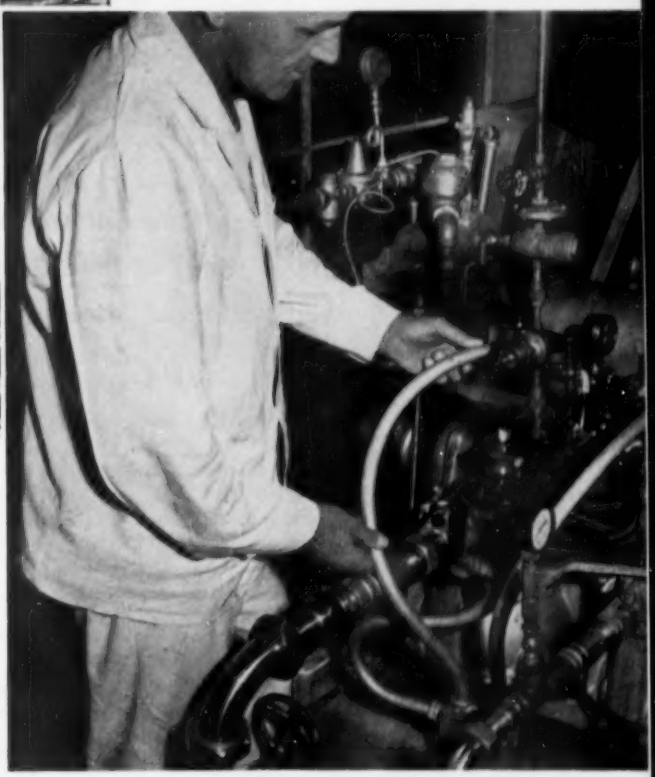
These five installations demonstrate some of the ways Sealtite reduces original wiring costs, gives greater protection to wiring, and ends conduit failure problems. There are others . . . an automobile manufacturer, for example, uses Sealtite on every piece of electrical equipment in his plant for quick replacement of motors, etc. A chemical company finds Sealtite gives 6 times longer conduit life than BX under corrosive conditions! Try Sealtite yourself!

TYPE U.A. is approved by Underwriters' Laboratory for service in wet spots. Copper conductor wound spirally inside conduit for positive ground. Sealtite's tough polyvinyl chloride jacket—extruded over flexible metal core—shrugs off corrosive chemicals, moisture and weather. **TYPE E.F.**† is extra flexible—ideal for machine tool and other applications. Meets J.I.C. standards. Available in machine tool light gray at no extra cost from mill stocks.

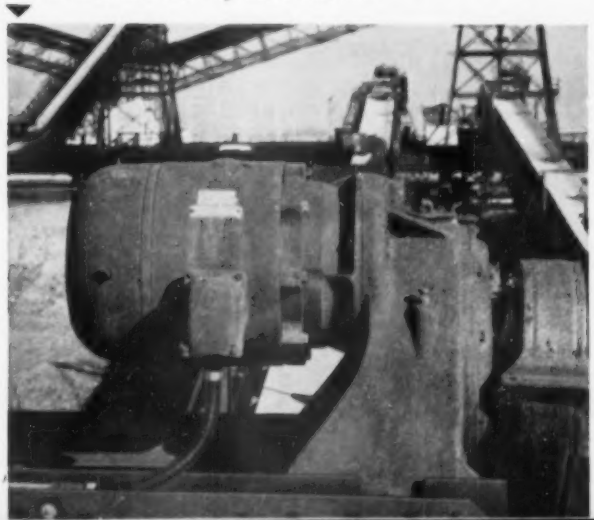
Electrical Wholesalers stock both types in easy-to-handle coils. Buy Sealtite in coils and cut it on the job without waste. Special liquid-tight connectors by Appleton, Thomas & Betts, Gedney or Pyle-National are available. For full information, write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. †Patent Applied For *Trade Mark 56190



A DAILY WATER WASHDOWN is given the machines of the Hoffman Beverage Co., Newark, N. J., bottling plant. Sealtite—used here to absorb vibration—affords perfect protection to wiring.



OUTDOOR EXPOSURE and the dripping of wet salt had no effect on installation of Sealtite by a well-known salt processing company—The Leslie Salt Co., San Francisco, Calif. Long life of Sealtite cut over-all cost far below that of so-called less expensive conduit.

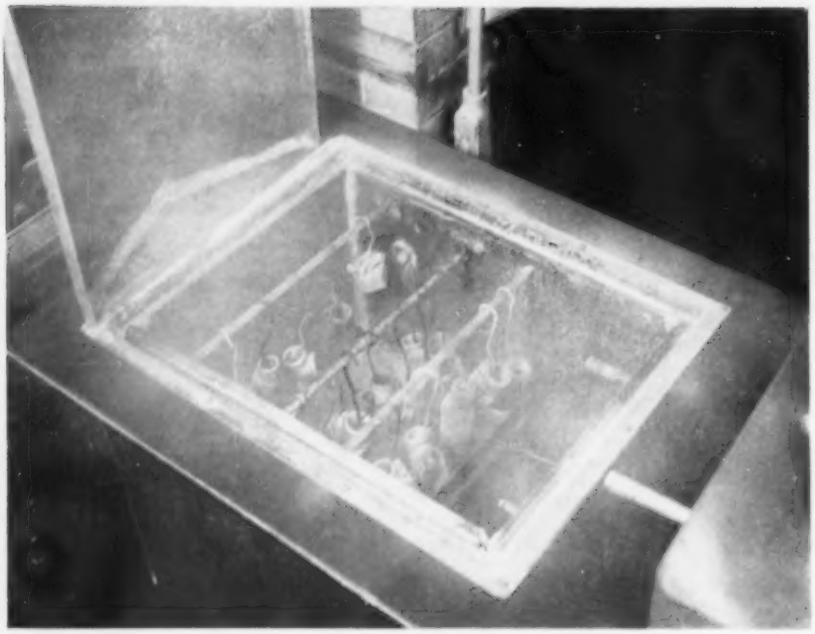


Insist on the original

SEALTITE

flexible, liquid-tight conduit

an ANACONDA® product



This is the standard salt spray equipment used by Killark to test the effectiveness of the newly developed protective coating for its line of aluminum fittings. This was one of the steps in a long series of tests to develop a surface protection that would extend well beyond the natural corrosion resistance of Killark's exclusive Alumalloy construction — and provide extra resistance even for highly abnormal atmospheres.

Electrical Conduit Fittings and . . .

THE FIGHT AGAINST RUST AND CORROSION

The Story of How Constant Killark Research is Producing Fittings of High Corrosion Resistance . . . Even in Abnormal Atmospheres

by James Grindell, Sales Manager, Killark Electric Mfg. Co., St. Louis

The expression "corrosion-resistant fittings" has been a part of this industry's vocabulary for a number of years—but, because it is a relative term, it has little descriptive value.

Consider the plated iron casting for example. True, this plate is of itself resistant to corrosive action. But once this surface protection is broken or interrupted through normal exposure or other means, the naked iron starts to rust immediately, continues to rust and flake off until the fitting is useless.

FIRST CAME THE ALUMINUM FITTING . . .

At a later date, our struggle against corrosion, came the cast aluminum fitting. The Killark Electric Mfg. Co. pioneered this field with its own exclusive Alumalloy—the first major improvement in electrical conduit fittings in over fifty years.

. . . THEN THE DIE-CAST FITTING

The cast aluminum fitting was followed by the Killark Die-Cast Aluminum Fitting. Not only was it aesthetically more attractive with its smoother interior and exterior, but it was found to be even more corrosive resistant because of its closer granular structure created by great die-casting pressures.

Competitively, Killark was in a position to sit back and say "never a finer fitting." But because pioneership frequently assigns the role of leadership, Killark was not content to produce a good fitting without asking "how can we make it even better?"

MOST MODERN CASTING METHODS

Three basic casting methods are employed:

1. Sand cast (gravity poured)
2. Permanent mold (gravity poured—steel dies)
3. Die Cast (pressure fed—steel dies)

The casting method used is determined by the nature and

shape of the individual fitting. With the recent addition of a 800 ton die cast machine extremely large size fittings can now be die cast.

Killark research has indicated that the metallurgical content of the aluminum alloy used in the casting is less important than the casting **surface.** The tighter the grain surface, the less chance for the elements to get between the metallic "grains" and begin their corrosive action.

KILLARK DEVELOPS SPECIAL PROTECTIVE COATING—added protection for Abnormal Conditions

Even with the most modern casting methods, the question reappeared: how can we make an even better fitting? What about those abnormal atmospheres of excessive corrosion activity? Out of such questions Progress is born.

The next logical step was the development of a protective covering to effectively aid in the fight for a better product. This added protection is a "first line of defense" in areas **where unusually corrosive chemicals are in constant use.** Even should this covering be penetrated, the aluminum still provides its own protective oxidation and close granular structure to resist further corrosion.

This new coating consists of an inert vehicle to which has been introduced a specially compounded ingredient that actually penetrates into the dense skin of the Alumalloy casting to become a part of the fitting—completely sealing even the most microscopic pores along the metal grain boundaries.

COATING EXCEEDS TESTING NEEDS

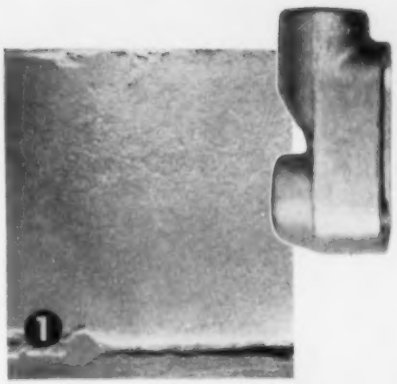
Is this additional protection warranted? The searching and impartial results of Standard ASTM Salt Spray Tests have already proved that no fitting stands up as does Killark. Competitive aluminum and plated iron fittings were subjected to this test along with the Killark-created. In a test where 125 hours are acceptable, the Killark Coated Fittings had already withstood over 300 continuous hours, when it was withdrawn for the photographs shown elsewhere on this page. Even then, **there was no evidence of any breakdown in the surface coating!** (Competitive fittings were withdrawn from the test after 125 hours, see photo).

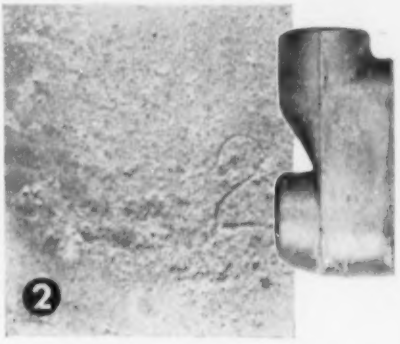
WHAT ABOUT THE FUTURE?

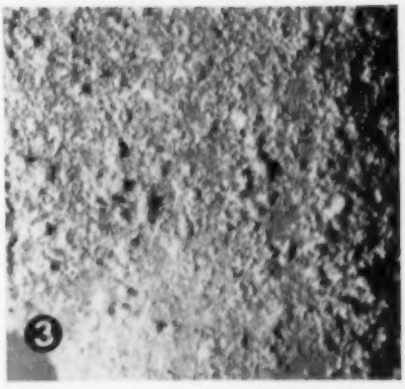
We think this entire Killark story of "Men Against Corrosion" is indicative of Killark's strong belief in continuing research. Because progress never stands still, Killark is always seeking better ways to serve the electrical industry. That's why we say . . .

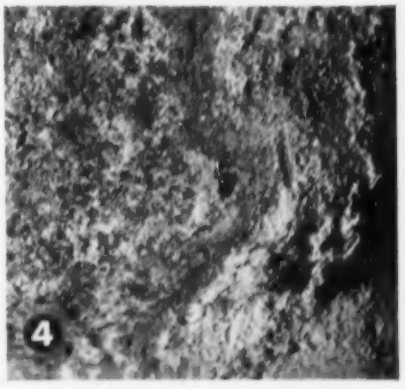
"FOR THE FINEST—AND THE LATEST—IN ELECTRICAL CONDUIT FITTINGS LOOK TO KILLARK"

The photos at the right show close-ups of the surfaces of several different types of fittings, and the varying corrosive effects of the salt spray on each. Photo no. 1 is a Killark fitting prior to the salt spray test, while photo no. 2 reveals the close-up surface of the same type Killark fitting (with special protective coating) *after* exposure to over 300 hours of the salt spray. The slight textural difference in no. 2 is due to salt encrustation, *not* corrosion. There is, in fact, no evidence of breakdown of any kind in the surface coating of No. 2. Photo no. 3 reveals what happens to the surface of a competitive aluminum fitting after a test period of only 125 hours. And photo no. 4 shows the highly pitted results on a cadmium plated iron fitting. The *same* photographic lighting conditions were used in producing all these photos.









Specify the *Levolier*® No. 71 WHERE SPACE IS LIMITED

It's only 15/32" thick

Here's just the switch you need for your streamlined lighting canopies and fixtures, and FHP motor housings where switch space is limited. Only 15/32" thick, Levolier No. 71 fits in the smallest spaces. It carries Underwriters' "T" rating on the famous Levolier mechanism that assures dependable, trouble-free switch performance. Furnished with durable molded phenolic case, patented lever control, pull chain and 6" wire leads.

SEND FOR THIS **NEW** McGILL CATALOG

Complete information on the complete line of McGILL *products*

Organized for ready reference, this beautifully illustrated 48-page catalog contains detailed information on Levolier® switches, McGill industrial lampholders, McGill lamp guards and parts and accessories. Ask for Catalog No. 84.

only McGILL *makes* *Levolier*® *Switches*

EXCLUSIVE CLAMP

JUST A FLICK - *you change a lamp* REAL QUICK!

Lamp changing is easier and faster with this exclusive thumb-release clamp. No tools are required to open or close the cage.

Levolier® No. 21 offers LOW COST DEPENDABILITY

in 3-amp switches

Especially durable — yet inexpensive, the Levolier No. 21 switch is the quality 3 Amp "T" 125 volt switch on the market today. It features pull-chain control and 6" wire leads permanently fastened to terminals by pressure connections. The molded phenolic case measures 1" x 1¼". Will accommodate mounting thickness up to 5/16". A desirable switch to put dependability into lower amperage current control.

McGILL®

ELECTRICAL SPECIALTIES

are always a little better and **ALL** *are Underwriters' Laboratories Inspected*

Available through leading Electrical Wholesalers

For complete information on McGill Electrical Products, write today for the new Catalog No. 84.

McGILL MANUFACTURING COMPANY, 450 N. Lafayette Street, Valparaiso, Indiana

Although Circle is one of the country's largest producers of building wire and cable, customers can still call headquarters direct for immediate personal attention.

WHY CIRCLE CAN "TURN HANDSPRINGS"

on shipments needed yesterday!

Your Circle distributor doesn't have to build any fires under us to get fast action on building wire and cable you need in a hurry.

That's because giving this kind of fast service is a basic policy of Circle's—the result of a flexible organization that's out of sympathy with "red tape," "stuffed shirts," and routine treatment of emergency orders.

When a Circle distributor wires or phones to ask for a shipment "needed yesterday," he knows he can get to anyone from the president on down—and get immediate personal attention.

Chances are, however, he rarely finds himself in that kind of a spot. His own ample stocks of top-quality Circle wire and cable are backed by a nearby completely-stocked Circle warehouse—*one of twenty-two* strategically located across the country.

That is why working through a Circle distributor is always your best assurance of adequate supplies—quickly and dependably delivered to the site. Circle Wire & Cable Corp., 5500 Maspeth Ave., Maspeth, Long Island, N. Y.

Circle maintains a national network of 22 well-stocked warehouses to help your distributor provide fast local deliveries of top-quality building wire and cable.

C W C **CIRCLE**

WIRE & CABLE
a subsidiary of
Cerro de Pasco Corporation

PLANTS: Maspeth and Hicksville, N.Y. **SALES OFFICES & WAREHOUSES:** Atlanta, Baltimore, Boston, Chicago, Cincinnati, Dallas, Des Moines, Detroit, Houston, Jacksonville, Los Angeles, Miami, Minneapolis, Nashville, New Orleans, Omaha, Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Seattle, St. Louis. **ADDITIONAL SALES OFFICES:** Cleveland, Davenport, Ia., Newark, New Haven, New York, Utica.

RUBBER COVERED WIRES & CABLES · VARNISHED CAMBRIC CABLES · PLASTIC INSULATED CABLES · NEOPRENE SHEATHED CABLES

WIRING DEVICE
PYLETS

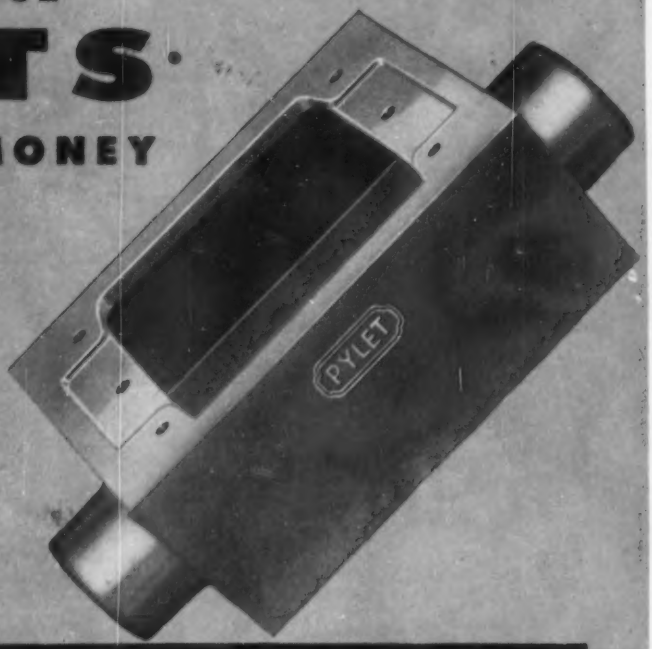
Save TIME and MONEY

Large wiring space in these PYLETS accommodates standard wiring devices of the flush mounting type.

A wide choice of interchangeable covers simplifies and reduces cost of changes in outlets and control stations.

Cast metal construction, with heavy cadmium plated finish, protects devices for long trouble-free service . . . reduces maintenance cost, replacement cost and shut-down time.

Adaptability of the PYLET body to so many types of circuit controls and service outlets permits substantial reduction in inventory and stocking costs.



FS and FD SERIES FOR ORDINARY LOCATIONS

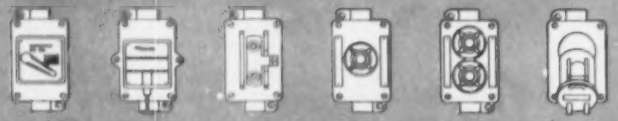
Water-Tight, Vapor-Tight and General Duty Types Available

ER SERIES FOR HAZARDOUS LOCATIONS

Explosion-Proof and Dust-Tight

Explosion-proof wiring device PYLETS are made in 1 and 2-gang combinations in shallow and deep types. They are supplied complete with cover and wiring device.

Literature Furnished on Request



Sold Nationally Through Authorized Distributors

THE PYLE-NATIONAL COMPANY

WHERE QUALITY IS TRADITIONAL

1344 North Kostner Avenue, Chicago 51, Illinois

SINCE 1897

Branch Offices and Agents in Principal Cities of the U.S. and Canada • Canadian Agent: The Holden Co., Ltd., Montreal
Railroad Export Department: International Railway Supply Co., 30 Church St., New York 7, N.Y.
Industrial Export Department: Rocke International Corp., 13 E. 40th St., New York 16, N.Y.

PLUGS AND RECEPTACLES • CIRCUIT CONTROLS • LIGHTING FIXTURES • FLOODLIGHTS

relies on Manson Tape for 59 years

Mr. James H. Conkell, Superintendent of the Ridgely Apartments, Birmingham, Ala. says, "In the past 59 years, I have used many brands of tape. I was sure that Manson was the best in 1897 when I first used it, and my long experience using Manson Tape convinced me that it is *still the best today*."

Mr. Conkell first used Manson Friction Tape when he was a lineman for the Postal Telegraph Co. of N. Y. in 1897. He recalls that when Postal re-routed their New York to Philadelphia line, each splicer carried a roll in his tool bag. In 1901, he worked on the rewiring of the Postal Telegraph office in Birmingham, and adds that he used a considerable amount of Manson Tape on that job.

During the past 38 years, Mr. Conkell has used Manson Tape continually in his work as building superintendent and has relied on its unchanging quality to give lasting protection to splices. And he has relied, too, for more than 40 years on his Okonite Tape Distributor, Matthews Electric Supply Company for quick service in maintaining his supply of Manson Tape.

Manson Friction Tape is manufactured from closely woven cotton fabric, frictioned with new, naturally tacky rubber compounded with the best chemical ingredients—all of which assure better adhesion and longer life. Mechanically strong, durable and long-lasting, Manson breaking strength is over 50 lbs. per inch of width, compared with ASTM's requirement of 40 lbs.

Manson assures permanent splices when used with Okonite or Okolite Rubber Tapes. Write for Okonite Splicing Tape Folder EC-1089.

...when you splice with:

AVAILABLE THROUGH AUTHORIZED DISTRIBUTORS ONLY

3968

Made by
THE OKONITE COMPANY
PASSAIC NEW JERSEY
SINCE 1878

SPECIALISTS IN ELECTRICAL WIRES, CABLES AND SPLICING MATERIALS FOR 75 YEARS

One in a series to emphasize the economy of Electrical Wholesale Distribution

"Electrical Wholesaler Distribution reduces the Manufacturer's selling cost and thereby reduces the selling price of electrical supply material to the user. Therefore, our policy has been to distribute Thomas & Betts products exclusively through the Electrical Wholesaler."*

LOOK FOR THIS SIGN — AUTHORIZED DISTRIBUTOR T&B ENGINEERED — IT'S THE MARK OF AN AUTHORIZED **T & B** DISTRIBUTOR

*Quoted from the T & B Plan of Wholesaler Distribution. If you would like to know the complete story of the T & B Plan, write:

THE THOMAS & BETTS CO.
INCORPORATED
34 BUTLER STREET, ELIZABETH 1, NEW JERSEY
THOMAS & BETTS, LTD., MONTREAL, P. Q., CANADA
MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

Bend without flattening, pull without snagging with General Electric EMT

Continuous weld seam on G-E EMT makes installation easier

Because the continuous weld seam on General Electric EMT eliminates weld metal, there are no burrs to snag conductors or tear insulation. General Electric's strong welded seam won't split or cause flattening during bending. *Controlled, continuous induction welding makes the difference.* G.E. adopted induction welding because it eliminates the sewing machine-like "stitch" produced by other types of welding. Induction welding means easier handling and faster wiring. General Electric EMT also offers these additional advantages:

COLORED BUNDLING TAPE for quick indication of size.

EASY BENDING because only the finest cold-rolled steel is used.

FAST WIRE PULLING because of the low-friction interior surface provided by Glyptal* lacquer and the smooth welded seam.

EXCELLENT CORROSION RESISTANCE because the interior is protected with tough Glyptal lacquer, and the outside is coated with electro-galvanized pure zinc.

FIND OUT how you can speed your wiring jobs with G-E EMT. See your General Electric Construction Materials distributor or write Section C60-618, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-mark General Electric Company

You can see the difference in these photographs. Compare axial cross section and interior surface of G-E EMT (left) with competitive brand (right). G.E.'s smooth weld is produced by continuous induction welding—and only General Electric EMT has it.

Progress Is Our Most Important Product

GENERAL ELECTRIC

15 AMP. 125 V.

POWER OUTLETS	No. 5261 Single, Flush	No. 5281 Single, on 4" Cover
	No. 5284 Single, Short Yoke	No. 5282 Duplex, on 4" Cover
	No. 5262 Duplex, Flush	No. 5260 Weatherproof, Flush
CAPS	No. 5263 Plastic	
	No. 5264 Armored with Cord Grip	
	No. 5266 Rubber with Cord Grip	
CONNECTORS	No. 5269 Plastic, Armored with Cord Grip	
	No. 5294 Rubber with Cord Grip	

15 AMP. 250 V.

POWER OUTLETS	No. 5661 Single, Flush	No. 5684 Single, Short Yoke
	No. 5662 Duplex, Flush	No. 5681 Single, on 4" Cover
		No. 5682 Duplex, on 4" Cover
CAPS	No. 5663 Plastic	
	No. 5664 Armored with Cord Grip	
	No. 5666 Rubber with Cord Grip	
CONNECTORS	No. 5669 Plastic, Armored with Cord Grip	
	No. 5694 Rubber with Cord Grip	

For New Safety in Portable Equipment Connections . . .

Here's A Full Line of Bryant Quality Grounding Devices

In compliance with National Electrical Code Paragraphs 2123-b, 2124-b, 2545, 2559, 2560, 4010

20 AMP. 250 V.

POWER OUTLETS	No. 9326 Single, Flush
	No. 9324 Single, on 4" Cover
CAPS	No. 9322 Armored with Cord Grip
	No. 9320 Rubber with Cord Grip
CONNECTORS	No. 9323 Plastic, Armored with Cord Grip
	No. 9321 Rubber with Cord Grip

30 AMP. 250 V.

POWER OUTLETS	No. 9303 Flush (Nos. 9301 and 9302 Plates)
	No. 9304 Surface in Aluminum Enclosure
CAPS	Nos. 9331 & 9305 Plastic
	No. 9337 Metal Covered with Cord Grip
CONNECTOR	No. 9341 Composition with Armored Cord Grip
CORD SETS	No. 9339 with Non-Removable Rubber Cap Available in 36, 48 & 60" Lengths

30 AMP. 250 V.

POWER OUTLETS	No. 3846 Flush with Plate
	No. 3926 Surface with Aluminum Enclosure
CAPS	No. 3833 Plastic
	No. 7513 Plastic with Cord Grip
CORD SETS	No. 3830 with Non-Removable Rubber Cap Available in 36, 48, 60 and 72" lengths

BRYANT

SUPERIOR WIRING DEVICES

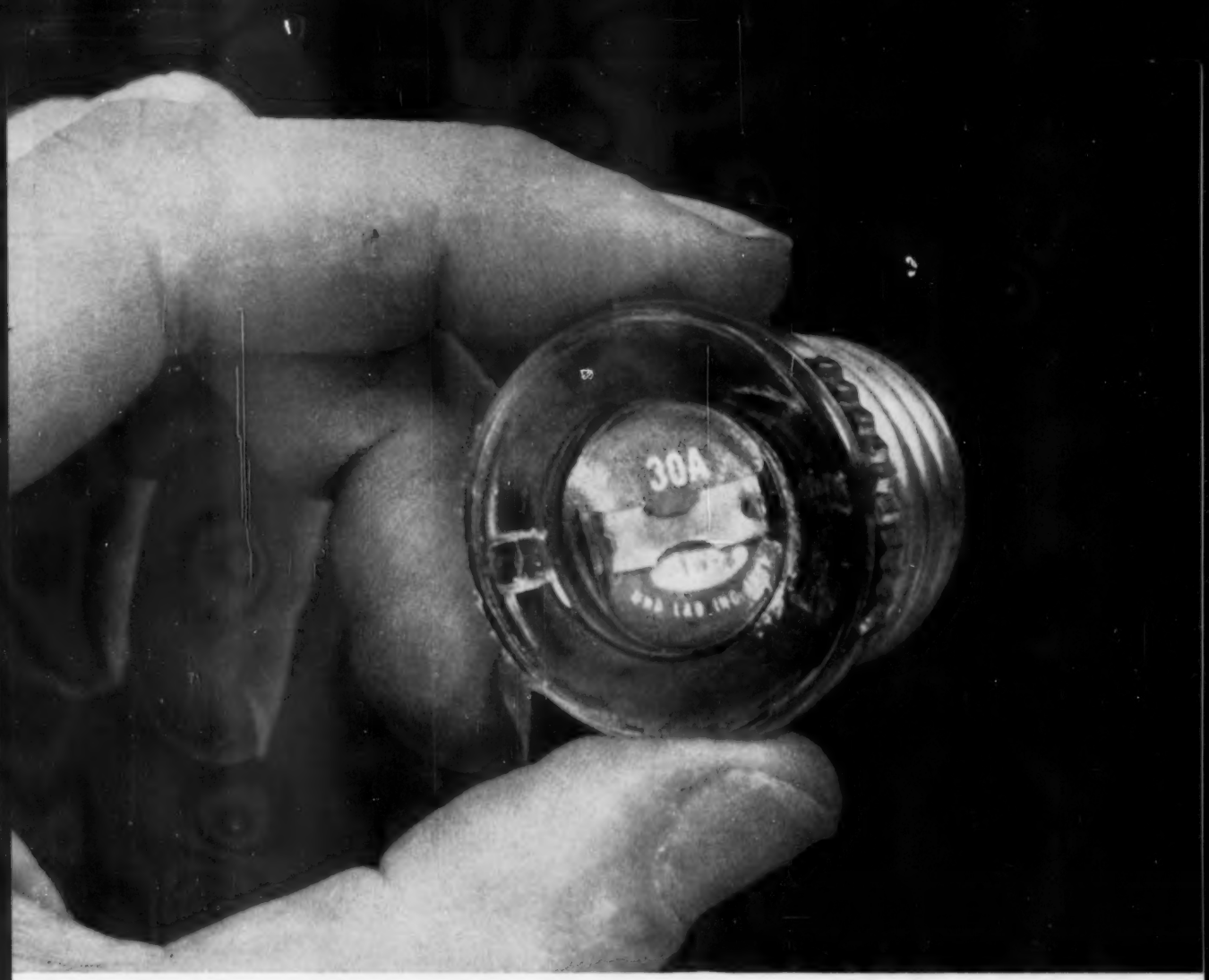
For complete listings, write to

THE BRYANT ELECTRIC COMPANY

Bridgeport 2, Connecticut

J-99942C

Chicago • Los Angeles



Are 30-amp. fuses

Picking your pocket?

A growing collection of appliances has many homeowners putting 30-amp. fuses on 15-amp. circuits. This practice is a dangerous, deceptive substitute for an adequate wiring job by a qualified electrical contractor.

Yet 34 million homes in the U. S. now need supplemental wiring, according to a recent survey. That doesn't include the million-plus housing starts expected annually. How many of these modernization jobs should be yours?

Modern materials help you sell modernization. More and more wire is being insulated with BAKELITE Brand Vinyl Plastic. This insulation is highly resistant to aging—to cracking, stiffening, oxidizing. You can assure homeowners that it keeps its physical and electrical properties far longer than older types.

BAKELITE Vinyl Plastic means easier installation, too. It permits faster and cleaner stripping and splicing than ordinary types because individual conductors in the cable have no braid or saturating compounds. It's listed by UL for 60 deg. C. (140 deg. F) building wire and for non-metallic-sheathed cable—including the all-plastic UF and NMC.

BAKELITE BRAND PLASTICS

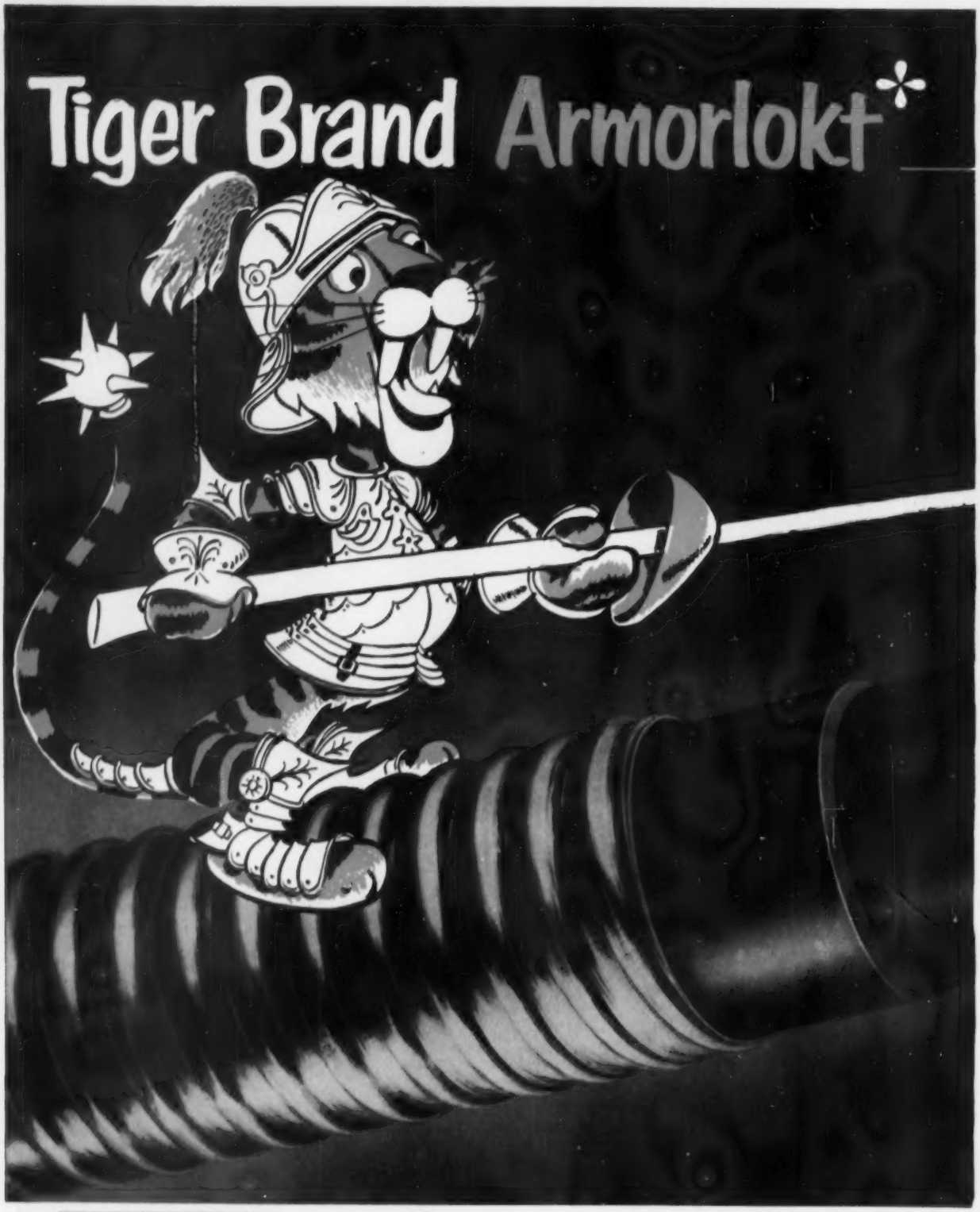
Remember—everyone benefits from ADEQUATE WIRING insulated with BAKELITE Brand Vinyl Plastic

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.

In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

Tiger Brand Armorlokt



SEE US AT THE NAED CONVENTION JUNE 10-14

interlocked armor cable

USS

UNITED STATES STEEL

now available up to 4″ core diameter

TO meet the demand for larger sizes, Tiger Brand Armorlokt cable is now being made in sizes up to four inches core diameter. Armor can be made from either galvanized steel or aluminum.

Tremendous installation savings are available with these larger sizes of Tiger Brand Armorlokt. The assembly weighs only about 1/3 as much as standard conduit/cable methods. There is no costly conduit bending and fitting. Splices can be made *anywhere* along the cable's length—and quickly, too.

Just call your nearest American Steel & Wire representative.

A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB!

- asbestos wire and cable
- mold cured portable cord
- aerial, underground and submarine cable
- shovel & dredge cable
- paper & varnished cambric cable
- machine tool & building wire
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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS Tiger Brand Electrical Wire & Cable

4 big ways to beat high insulating costs

Tool up with

DUTCH BRAND'S BIG FOUR ELECTRICAL TAPES

Send for this new Big Four booklet now!

Here are facts that you can turn into dollars and cents! Dutch Brand's big, new "Big Four" booklet is packed with new ideas and methods for beating high electrical insulating costs. It tells how you can use Dutch Brand plastic tape, friction tape, rubber tape and vinyl color tape to improve electrical work . . . make jobs easier, faster and safer. You'll see exactly what these tapes will do . . . and find out how to choose the right tape to meet specifications of the job. Get a copy of this easy-to-read, well illustrated booklet for every department concerned with electrical insulation.

JOHNS-MANVILLE DUTCH BRAND PRODUCTS OF QUALITY

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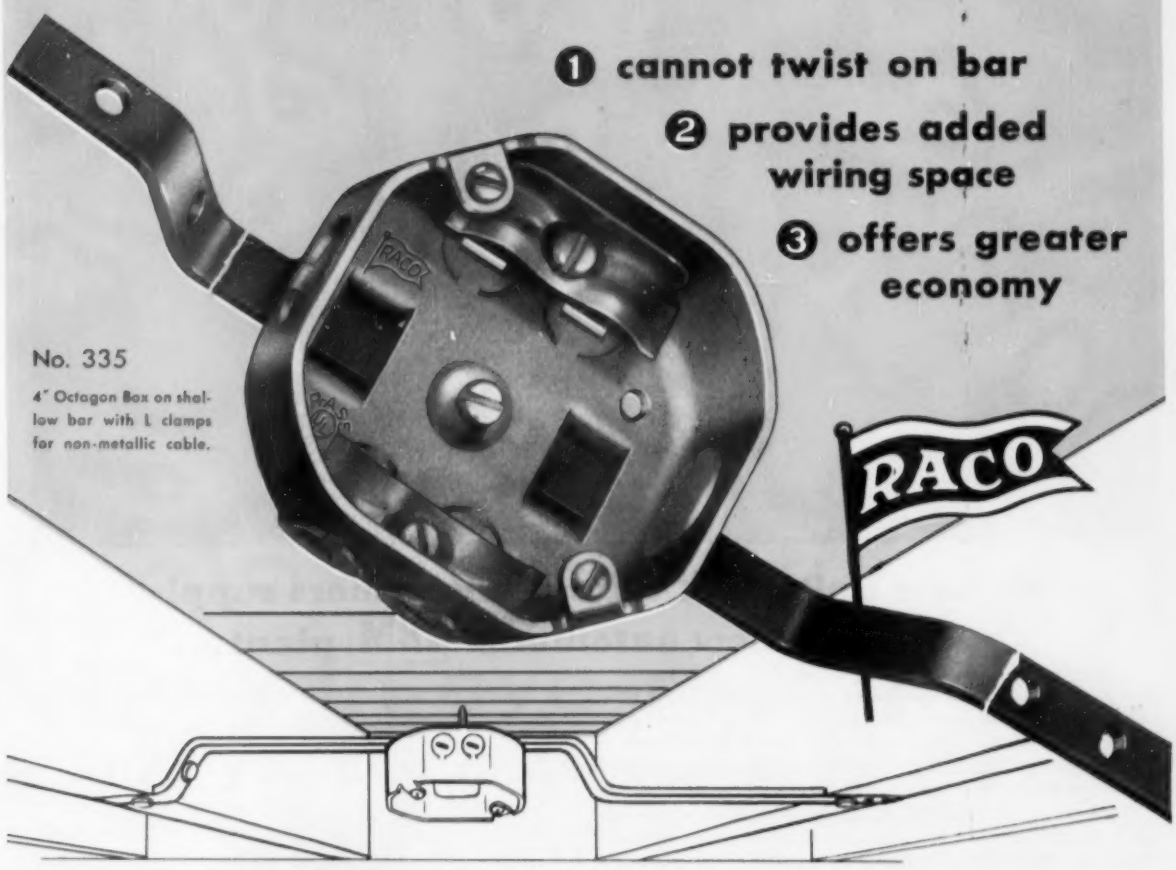
PRODUCTS
7800 WOODLAWN AVENUE • CHICAGO 19, ILL.

New RACO NO-STUD SET-UP BOX

SAVES TIME • SAVES MONEY on every ceiling installation!



❶ cannot twist on bar

❷ provides added wiring space

❸ offers greater economy

No. 335

4" Octagon Box on shallow bar with L clamps for non-metallic cable.

USE NEW RACO NO-STUD SET-UP BOXES ON ALL THOSE COMPETITIVE JOBS

CEILING FIXTURES — CLOSET LIGHTS — ATTIC LIGHTS
PORCH FIXTURES — BATHROOM LIGHTS — BASEMENT JUNCTION BOXES
AND SIMILAR INSTALLATIONS

You save money both ways with this New Raco No-Stud Set-Up Box . . . lower first cost and lower labor cost on installation. It enables you to make real money on those competitive jobs.

Hardened set-screw with locking point secures box in desired position. Box cannot turn or twist on bar. No stud means more wiring space . . . faster and easier installation.

Two Popular Sizes

3½" OCTAGON

On Shallow offset bar with Raco L clamps for non-metallic cable only.

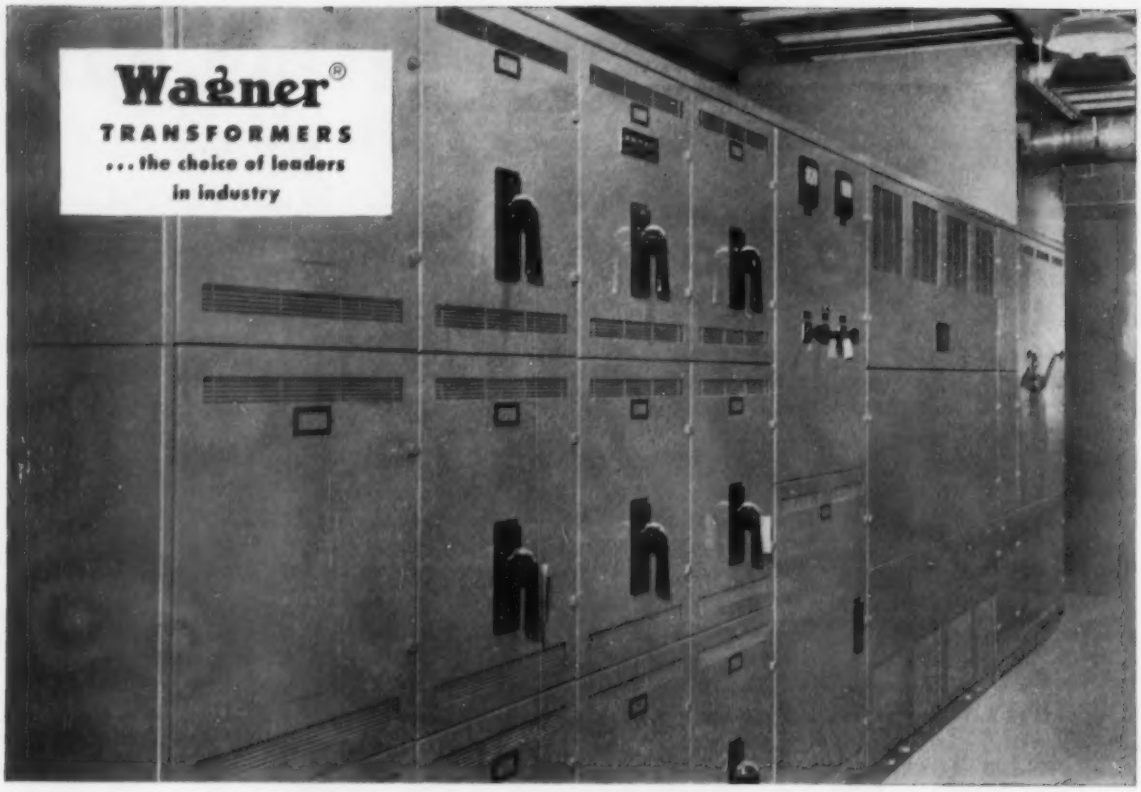
4" OCTAGON

On Shallow or deep offset bars. Complete with X clamps for metallic cable or L clamp for non-metallic cable.

WRITE TODAY . . . GET ALL THE FACTS

"A RACO BOX FOR EVERY NEED"

ALL-STEEL EQUIPMENT INC. *Aurora, Illinois*



Wagner Unit Substation Transformers supply power for new automated IBM plant...

IBM's new fully-automated plant at Kingston, New York, utilizes modern load centers for in-plant electrical distribution. The unit substations in this load center system bring power at high primary voltages close to the load to reduce voltage drop and conductor losses.

The 1000 kva unit substation, shown above, delivers 480 volt three phase power to large machines and equipment. Another 500 kva double-ended substation supplies 208Y/120 three phase power for lighting and small power loads.

These unit substations are equipped with Wagner dry-type Transformers because Wagner transformers are carefully engineered to meet heavy industrial demands—are built to stand up under rigorous 24 hour a day production schedules.

Wagner Unit Substation Transformers are *"Predesigned"*. They are built in standard ratings which are coordinated with the specifications of unit substation builders. This completely eliminates individual job engineering—saves time—reduces costs. You get a proven design in a completely assembled and tested transformer—and get quick delivery.

Consult the nearest of our 32 branch offices or write for Bulletins TU-205 and TU-214. They give full information on Wagner Unit Substation transformers for industrial power distribution systems.

New IBM Kingston, N. Y. plant is fully automated. It produces printed circuits and electric typewriters.

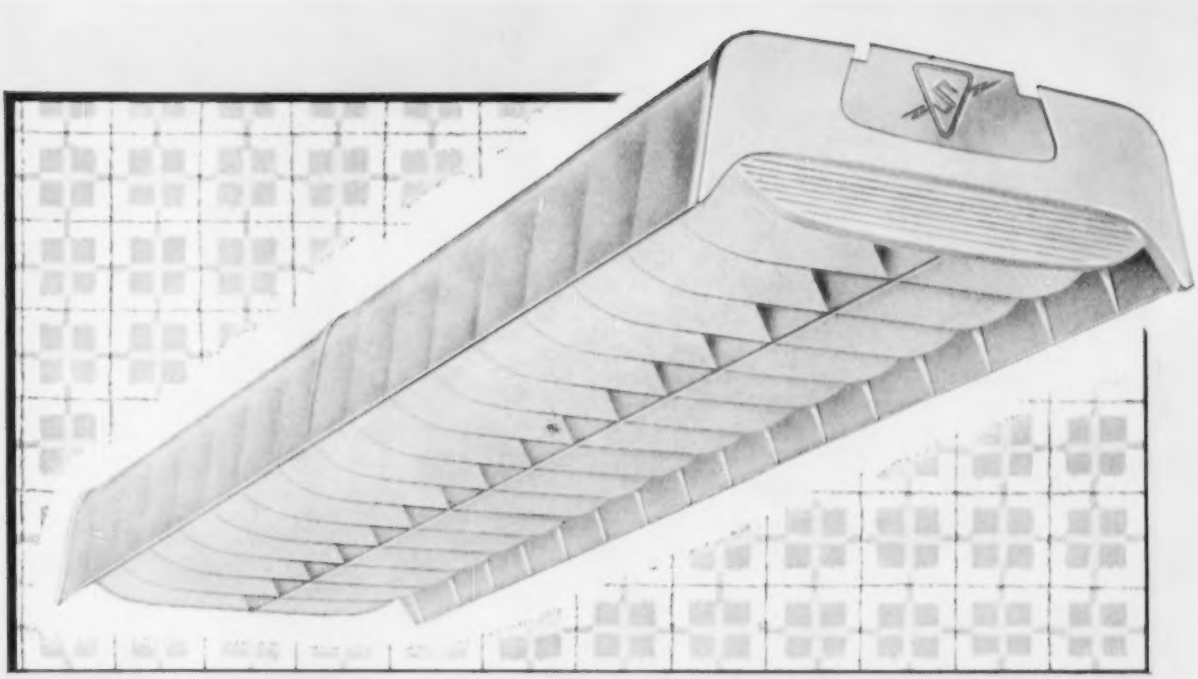
...to help America LIVE BETTER—*Electrically*

LIVE BETTER ELECTRICALLY

Wagner Electric Corporation
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.

156-9

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES



The Scott... *by Sylvania*

Now in eye-rest green

to bring you new dimension in lighting design

TODAY, *color* makes the headline news in lighting design! And this new version of the famous Scott all-luminous fixture by Sylvania—with Eye-Rest Green color blended into its all-plastic shielding—adds the exciting new dimension of *color* to the traditional dimensions of *quality* and *quantity* of lighting.

Visualize the wide new range of creative design possibilities opened up to you! Eye-Rest Green is a cool, comfortable color; suggests an atmosphere of pleasant efficiency. It's a delight to behold—a comfortable sight-saver to work by—something new and different for you to recommend.

The Scott in Eye-Rest Green incorporates all the fine features of the original Scott fixture—high-illumination efficiency, strikingly clean design, and one-piece molded plastic shielding which is light-weight and easy to remove for cleaning and lamp changes.

The Scott in Eye-Rest Green provides ideal lighting for offices, libraries, sight-saving classrooms, close-work areas where comfortable lighting levels are to be maintained. Mail the coupon for complete specification data.

SYLVANIA... fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

THE SCOTT IN WHITE PLASTIC
Headliner of this famous Sylvania fixture line, has extremely high 89.8% illumination efficiency.

SEND COUPON FOR FREE, INFORMATIVE BOOKLETS

Sylvania Electric Products Inc., Dept. F40
Lighting Division—Fixtures, One 48th Street, Wheeling, West Virginia

- ☐ Please send me complete information on The Scott in Eye-Rest Green.
- ☐ Please send catalog sheets on both versions of The Scott.
- ☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

Organization_____ Address_____

City_____ Zone____ State_____

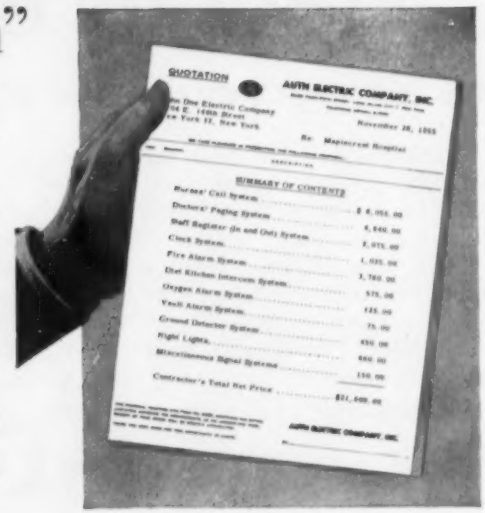
"Better Get a Price from Auth"

That's a suggestion every electrical contractor should make to his estimator when they work up a bid on the electrical construction of a hospital, housing project, school, etc.

Why? Because the signaling and communication systems in these projects today are big and diversified—they cost real money . . . and because Auth's experience in producing these systems is so great that our price *has* to be important.

By this we mean that the contractor can rely upon our price to cover the requirements of the plans and specifications . . . that he will always find it reasonable, and often it may help him get a job. Auth systems are invariably approved by architects and engineers.

Many electrical contractors will not complete a bid that includes a signaling or communication system without getting Auth's price. How about you? Will you be sure to tell your estimator "Better get a price from Auth?" Sooner or later it will pay off.



Auth
SINCE 1892

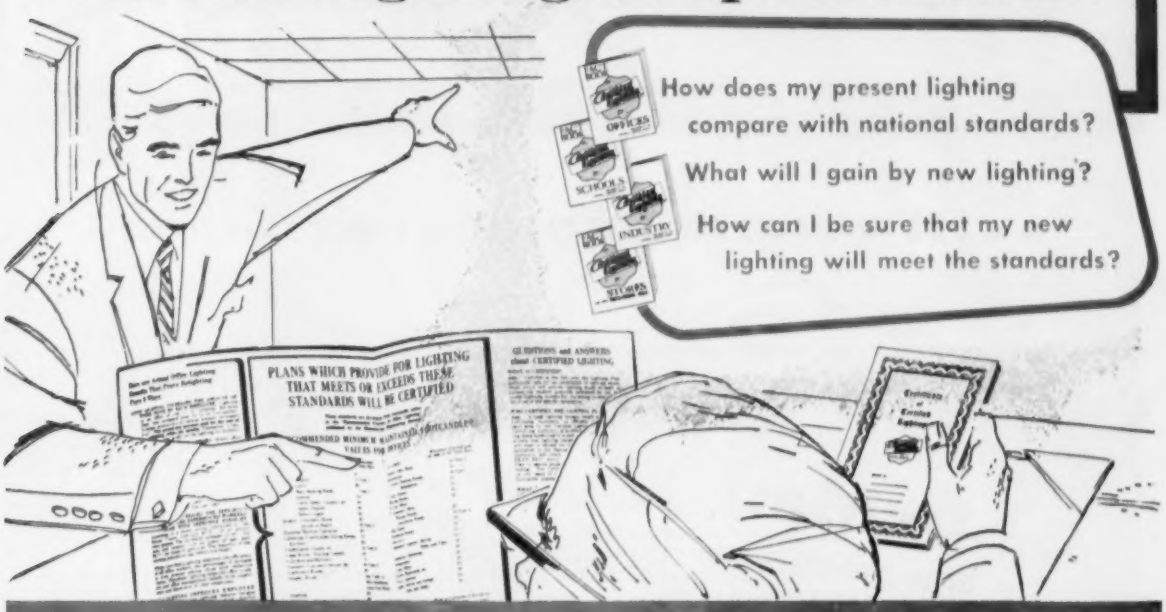
Manufacturers of
ELECTRICAL SIGNALING, TIME AND COMMUNICATION SYSTEMS FOR HOSPITALS, SCHOOLS, HOUSING, INDUSTRY AND SHIPS

Sold in cooperation with the distributor

Auth Electric Company, Inc.

LONG ISLAND CITY 1, NEW YORK

The 3 Most Important Questions On Your Lighting Prospect's Mind!


How does my present lighting compare with national standards?
What will I gain by new lighting?
How can I be sure that my new lighting will meet the standards?
PLANS WHICH PROVIDE FOR LIGHTING THAT MEETS OR EXCEEDS THESE STANDARDS WILL BE CERTIFIED

Use the FACT BOOKS for the answers! Then use the CERTIFICATE to clinch the sale!

Sell more and bigger lighting jobs by using the Fact Books of Certified Lighting in your sales approach. They are available to electrical contractors and others wherever the Certified Lighting program is in operation. Use them to show your prospect the national standards and how his present lighting compares with these standards. There is a Fact Book for each type of lighting — for store . . . office . . . school . . . and factory. Use the Fact Books also to show how your plan is certified by an impartial authority and countersigned by you to guarantee that the installation meets national standards. Then . . . use the guarantee certificate itself as the final sales clincher to prove your recommendation is *right in plan — right with standards — right for installation.* Send for free booklet and *free* copies of the four FACT BOOKS today!

Is Certified Lighting In Operation in Your Area?

This program is operated locally under the joint sponsorship of all electrical groups. If your area is listed below, get in touch with your local group . . . otherwise, write The National Lighting Bureau.

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R-1248

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Certified Lighting for a Better America

Certified Lighting

NATIONAL LIGHTING BUREAU, 155 East 44th Street, New York City, Sponsored by the Industrial and Commercial Lighting Equipment Section of NEMA the National Electrical Manufacturers Association

This program is sponsored by all these member companies of the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association to help you increase your sales . . .

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If it's worth Engineers' time . . .

. . . It's worth Engineered Cable

Belden

INTERCOMMUNICATING AND SOUND SYSTEM CABLES

Indoor-outdoor, phones or speakers—there is a Belden engineered cable to meet your needs for a permanent, trouble-free installation.

"Items from the Complete Belden Line"

The TV station, the systems for music, paging, and intercommunication in the new Prudential Insurance Company of America's Building in Chicago have been—wired by Belden.

Belden

WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

8-8

Magnet Wire • Lead and Fixture Wire • Power Supply Cords, Cord Sets and Portable Cord • Aircraft Wires
Welding Cable • Electrical Household Cords • Electronic Wires • Automotive Wire and Cable

Kirlin SYSTEM

BUILT-IN *Lighting*

if you ask for it... INSIST on getting it!

YOUR LONG-RUN PROFITS DEPEND ON THE FIXTURE ITSELF!

If you are looking to a future increase in your business and your profits—be sure you get KIRLIN Fixtures when you ask for them. Their many advantages for your customers, and the greater light output, help to build good will for your business. Their many direct advantages to you, such as easier and quicker installation, make more money for you.

However, KIRLINs are being imitated in appearance just like the leading products in other fields are imitated. The distinctive color combination on recessed fixtures, the white frame and bright metallic door, was originated and *copyrighted* by KIRLIN; how many other makes can you name who have tried to make their fixtures "look like KIRLINs?"

These exclusive features and policies have yet to be equalled:

★ *GREATEST VARIETY OF LENSES*

★ *SOLD ONLY THROUGH TRADE CHANNELS*

★ *GENUINE GLASSURFACED ALUMINUM REFLECTORS*

• MADE IN ALL SIZES — SQUARE OR RECTANGULAR — AND IN FLUORESCENT

• WIDE-ANGLE OR CONCENTRATING LENS • EASILY INSTALLED BETWEEN JOISTS • IN STOCK AT LEADING WHOLESALERS • UL AND IBEW LABELS

LARGEST SELLING RECESSED LINE—MILLIONS IN USE EVERYWHERE

The KIRLIN CO. 3435 E. JEFFERSON AVE. DETROIT 7, MICHIGAN

S-130 kit obsoletes all other equipment for Slashes

NEW S-130 Bender
$189.00
Includes 10-ton "Porto-Power" hydraulic unit plus equipment for bending 6 sizes of pipe and rigid conduit, ½ inch thru 2 inches.

90° bends in 1 setup! New Blackhawk Pipe Bender offers new portability, new precision

Labor and material costs tumble dramatically with the new S-130 bender. That's because precise bends are made at amazing speed — *right on the job* — and practically all need for expensive factory-formed ells is eliminated! Put these advantages and savings to work right away!

New Featherweight Aluminum Alloy frame and shoes are rigid and strong — yet surprisingly lightweight for greater portability, easier assembly and maneuverability on the bench, around the floor, or overhead.

ALL Blackhawk Hydraulic

WITH ELECTRIC-POWER . . . put a 90° bend in 2" pipe in less than 60 seconds! End all hand pumping! Turn out "production" bends three to six times faster. Simply use a P-182 Blackhawk portable *electrically-driven* hydraulic pump. It costs only $315.00 and can pay for itself on the first job. Works on *any* hydraulic bender. Can be used on all "Porto-Power"® equipment.

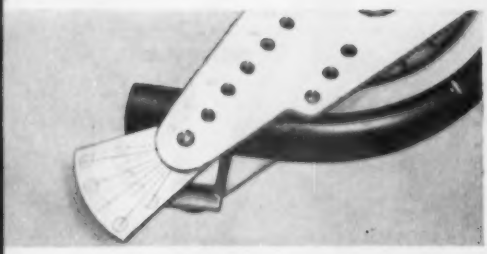
A COMPLETE LINE OF PORTABLE BENDERS — There's always a Blackhawk pipe bender to do the job at lower cost. S-34 bender, above, puts zip in bending of thin-wall conduit, 1 thru 2-inch diameters. S-30A 10-ton assortment handles rigid conduit and pipe, 1 thru 2-inch. S-36 20-ton assortment bends rigid conduit and standard pipe, 1¼ thru 4-inch.

Speed-minded contractors and crews everywhere are changing to Blackhawk Hydraulic Tools — doing it the easy way — for better morale, better work, and better business. Why don't *you?*

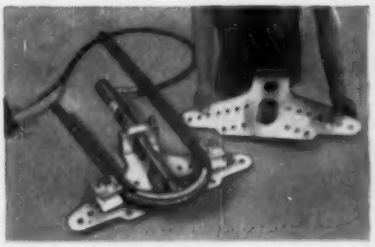
See your electrical wholesaler or industrial distributor today. For free descriptive literature write, without obligation, to Blackhawk Mfg. Co., Dept. H-2065, Milwaukee 46, Wisconsin.

bending ½ thru 2-inch rigid conduit and pipe . . .

bending costs!



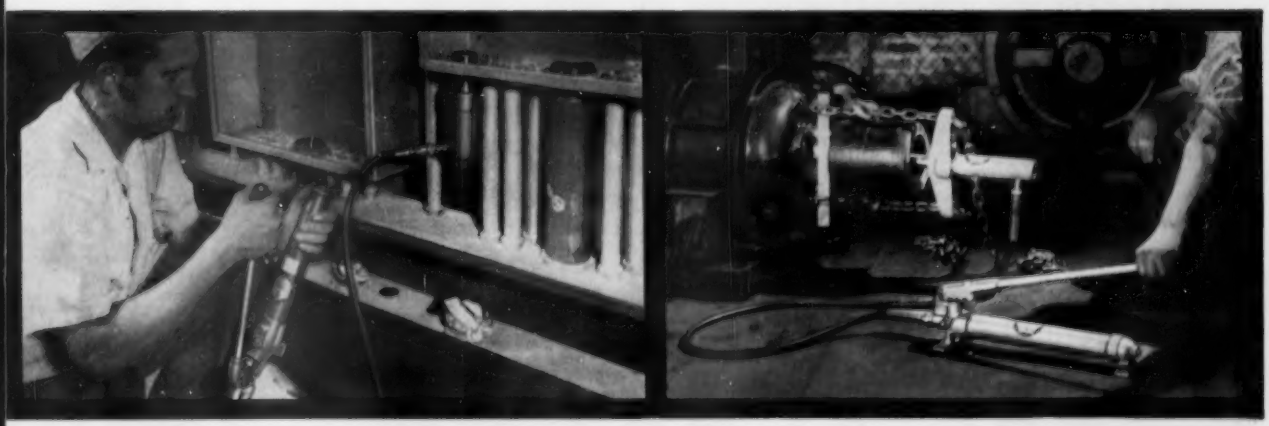
NEW "OPTIK-ANGLE" GAUGE eliminates guesswork and time-wasting measuring in controlling degree of bend — shown by above simple gauge, which is mounted right on bender.



NEW LONGER STROKE RAM extends to full 10 inches. Makes 90° bends in one stroke and with only one setting of pipe in the shoes. Also forms bends up to 180° faster than ever!

NEW REMOVABLE TOP PLATE—"Lock-On" shoes speed setups — eliminate need of threading shoes on ram. Simply set in place. Pipe quickly positioned from above. One latch unlocks top plate.

Tools bring ease, speed, profit to electricians



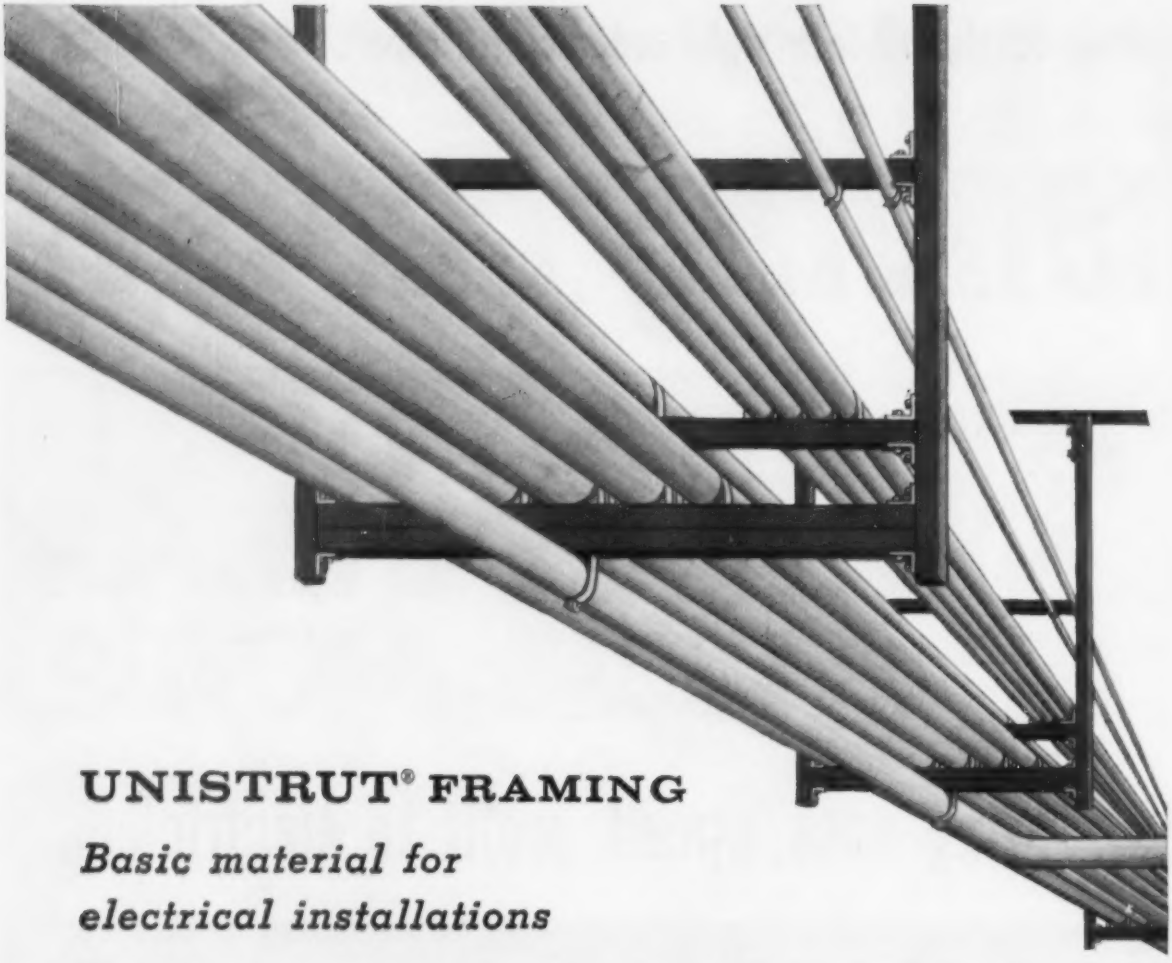
HANDY LIGHTWEIGHT KNOCK-OUT PUNCHES ARE 60% FASTER! Now you can get Blackhawk hydraulic Knock-out punch equipment any way you want it — in kits to fit your work and budget. Speedy hydraulic unit is now 9 lbs. lighter, lower in cost. Gets in tight places. No wrench to swing — no bashed knuckles. You get neater holes, more ease and safety.

THESE HYDRAULIC TOOLS DO 1001 OTHER BIG JOBS! The same "Porto-Power" hydraulic units that power Blackhawk electricians' equipment lick dozens of allied push, pull, bend, clamp, press and lift jobs — speed up scores of tasks, as in fast pulley pulling above. You get so *much more* for your money from Blackhawk Pipe Benders and Knock-Out Punches.

BLACKHAWK®

World's largest manufacturer of HYDRAULIC TOOLS

(Prices subject to change without notice)



UNISTRUT® FRAMING

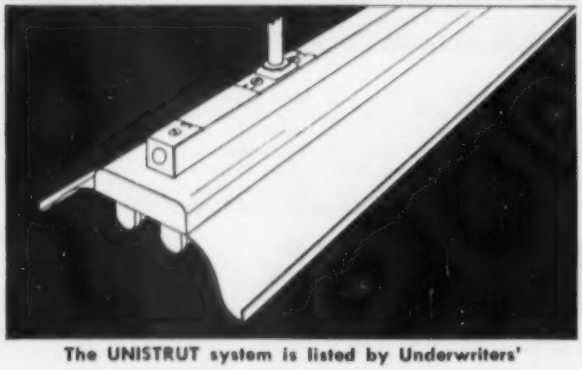
Basic material for electrical installations

World's Most Flexible All-Purpose Metal Framing.

For supporting conduit and cable in any installation, UNISTRUT offers the quickest, simplest assembly. It makes a clean, professional installation and is strong enough to support the heaviest run. With UNISTRUT Channel and Concrete Inserts even the trickiest installation is simplified. Capacities may be easily expanded to take care of future growth. All types of fittings, clamps and brackets are available. See your UNISTRUT distributor. Write for new Bulletin FF-5.

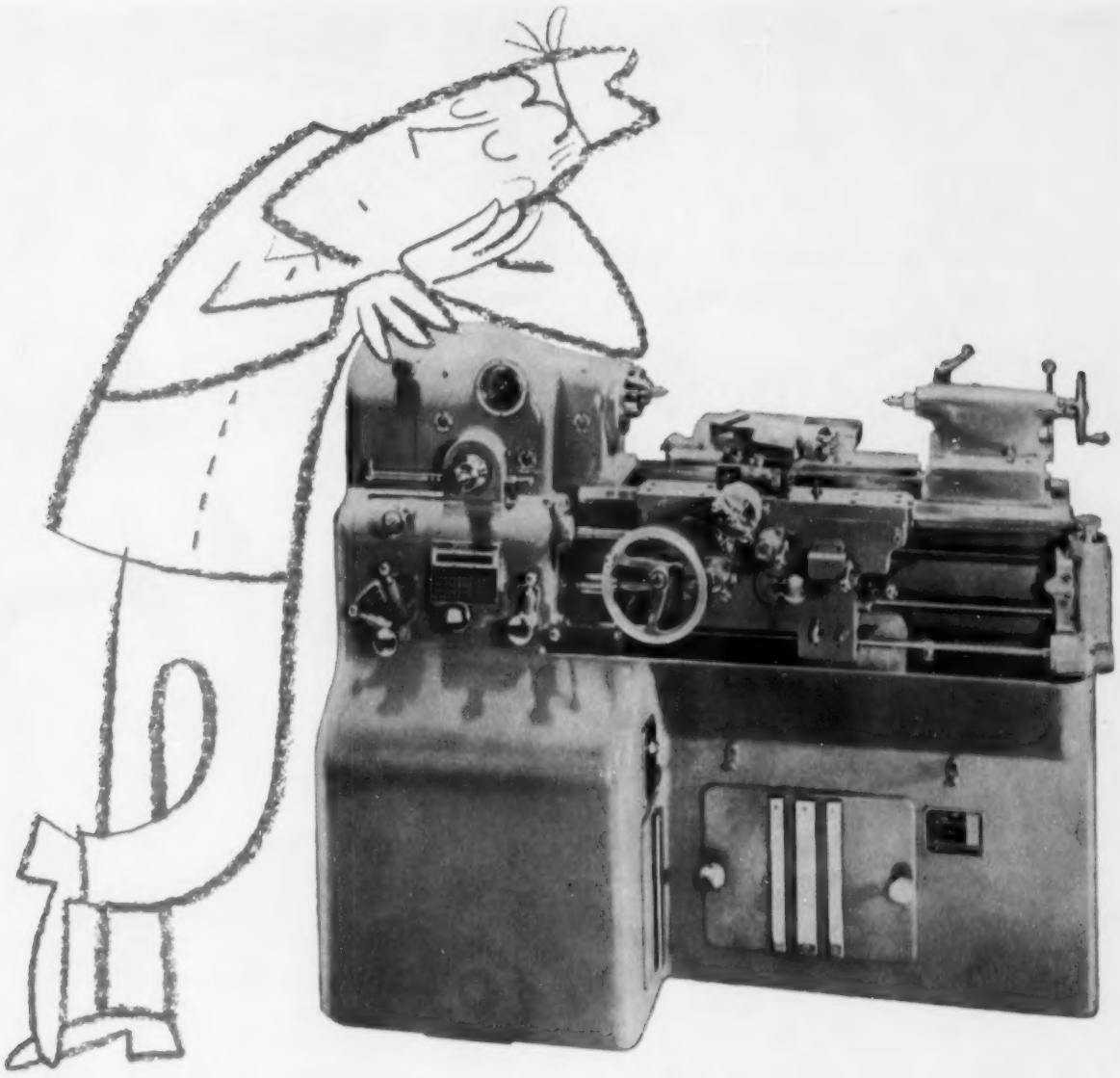
UNISTRUT PRODUCTS COMPANY, Dept. E-6
933 W. Washington Blvd., Chicago 7, Illinois

U.S. Patent Numbers 2327587 2329015 2360379 2383382 2345650 2541908 2405631 2696139 Other Patents Pending



The UNISTRUT system is listed by Underwriters' Laboratories, Inc. and may be used as a raceway.

Quickly installed, UNISTRUT Channel is rigid and strong, giving perfect, permanent alignment.



Why risk production downtime?
Keep it going with circuit breaker protection

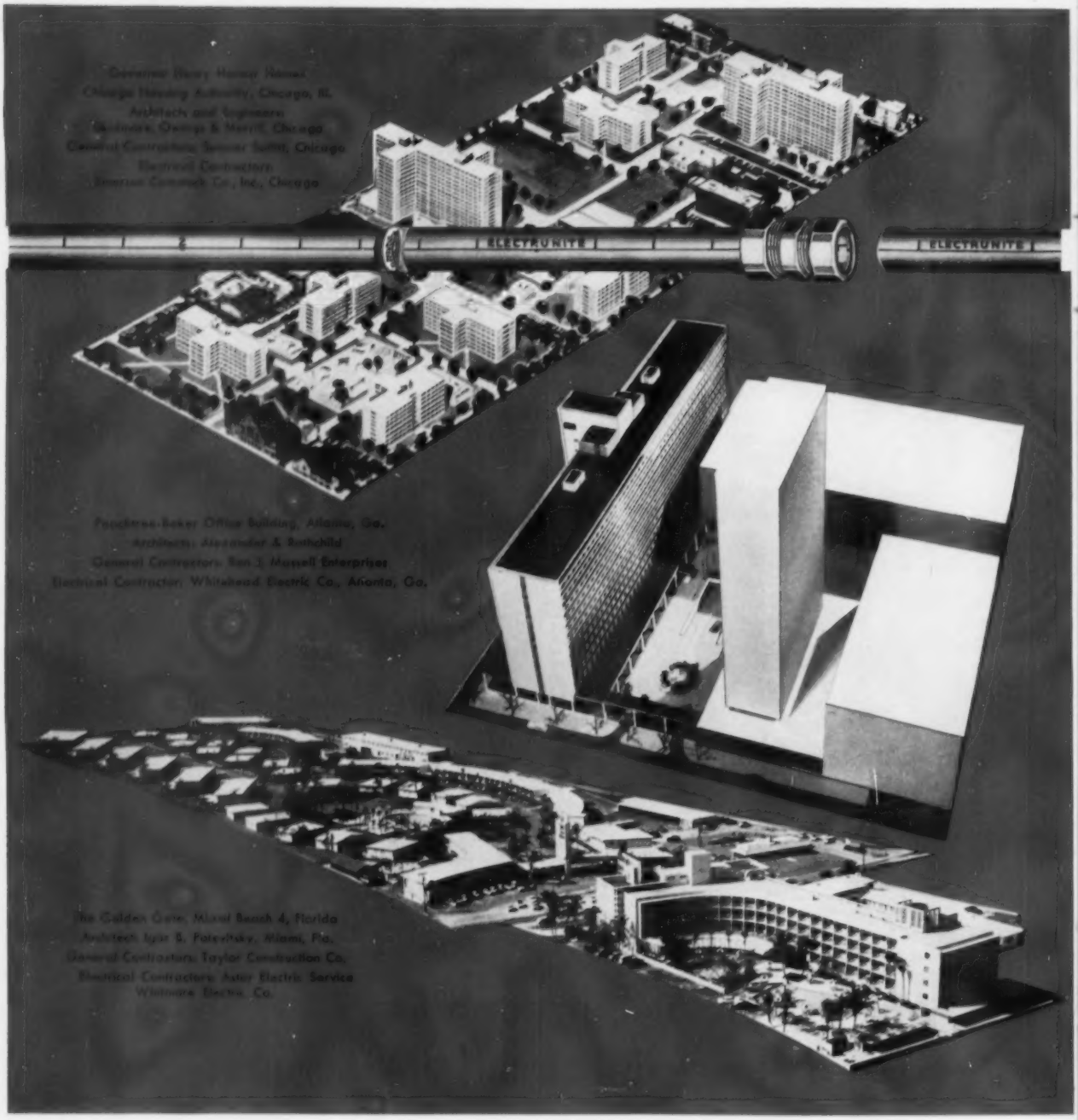
Type "ETI" F frame breaker

Keeping a machine and its operator idle while locating and replacing a blown element costs industry countless thousands of dollars each year. There's no need for such waste. Replacing outmoded protective devices with I-T-E circuit breakers can cut this loss materially. Then when overloads or short circuits occur, there'll be no waiting, no costly machine downtime, no production bottlenecks, no replacement of parts. The tripped breaker is easily spotted and can be reset as soon as the fault is cleared.

Investigate the economy of circuit breaker protection. See your local I-T-E distributor today. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.

I-T-E

I-T-E CIRCUIT BREAKER COMPANY • Small Air Circuit Breaker Division



REPUBLIC

REPUBLIC STEEL

World's Widest Range of Standard Steels

Work-saving features make Republic ELECTRUNITE E. M. T. more economical to install in big concrete jobs

EXCLUSIVE FEATURES

"Inch-Marked" and "Guide-Lined" make any installation easier

Nearly 100 miles of Republic ELECTRUNITE® E.M.T. went into those big concrete installations pictured at the left. And on each job the handy "Guide-Lined" and "Inch-Marked"® features helped electricians stay well ahead of the concrete boys . . . and keep costs down.

Republic's exclusive Inch-Marking feature speeds accurate cutting and bending. Every inch of the tubing is marked in feet and inches to eliminate the awkward problem of using a flat rule on a round tube.

The Guide-Line, which extends the full length of the tubing, simplifies the bending operation. By aligning with the arrows on the Republic Calibrated Bender, it's easy to keep bends in the correct plane—avoid costly "wows." Both features come on all popular sizes.

There are no threads to cut, no lines to turn when you use ELECTRUNITE E.M.T. Joining is accomplished by couplings and connectors. To make joints tight, you simply turn the nut, not the entire run. Once installed, still another Republic exclusive—Inside Knurling—makes wire pulling and "fishing" easier.

Republic ELECTRUNITE E.M.T. is perfect for use with concrete. It's approved by the National Electrical Code for concealed, exposed, and concrete slab installations—provides effective protection for all electrical circuits, call systems, and television leads from moisture, fire and mechanical injury.

Whether your next job is concrete or not, you can save money by installing Republic ELECTRUNITE E.M.T. Be sure you ask your electrical distributor for the E.M.T. that's "Inch-Marked" and "Guide-Lined." Mail coupon for literature giving complete specifications.

IT'S EASY TO MEASURE Republic ELECTRUNITE E. M. T. because every inch and foot is clearly marked along the entire length on ½", ¾", 1" and 1¼" sizes. There's no need to struggle with a flat rule on a round tube. You simply measure the distance, not the tubing.

IT'S EASY TO BEND Republic ELECTRUNITE E. M. T. more accurately, thanks to the longitudinal Guide-Line on ½", ¾", 1" and 1¼" sizes. By aligning the "Inch-Marks" and the Guide-Line with calibrations on the Republic Bender, true offset, back-to-back and saddle bends are a cinch to make.

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
STEEL & TUBES DIVISION
212 East 131st Street
Cleveland 8, Ohio

Gentlemen:
Please send me additional information on Republic ELECTRUNITE "Inch-Marked" E.M.T.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

C-2105

Model CA Ventura Attic Fan with side panels for ceiling mounting.

Here's the new attic fan that's twice as easy to stock and install!

. . . twice as easy because you use only *one* type of fan – the model CA Ventura Attic Fan – for ceiling *and* wall installations. You stock only one basic fan in the popular 24, 30 and 36-inch sizes. (This alone means a saving of twice the inventory and storage space.)

And one basic model means easier installation, too! Each fan is available with a set of side panels, rubber cushion strips and all the necessary hardware. On ceiling installations, you can attach the panels in minutes – right on the job! On vertical installations, the fans are complete – ready to install!

Why not call our nearest branch today for full information.

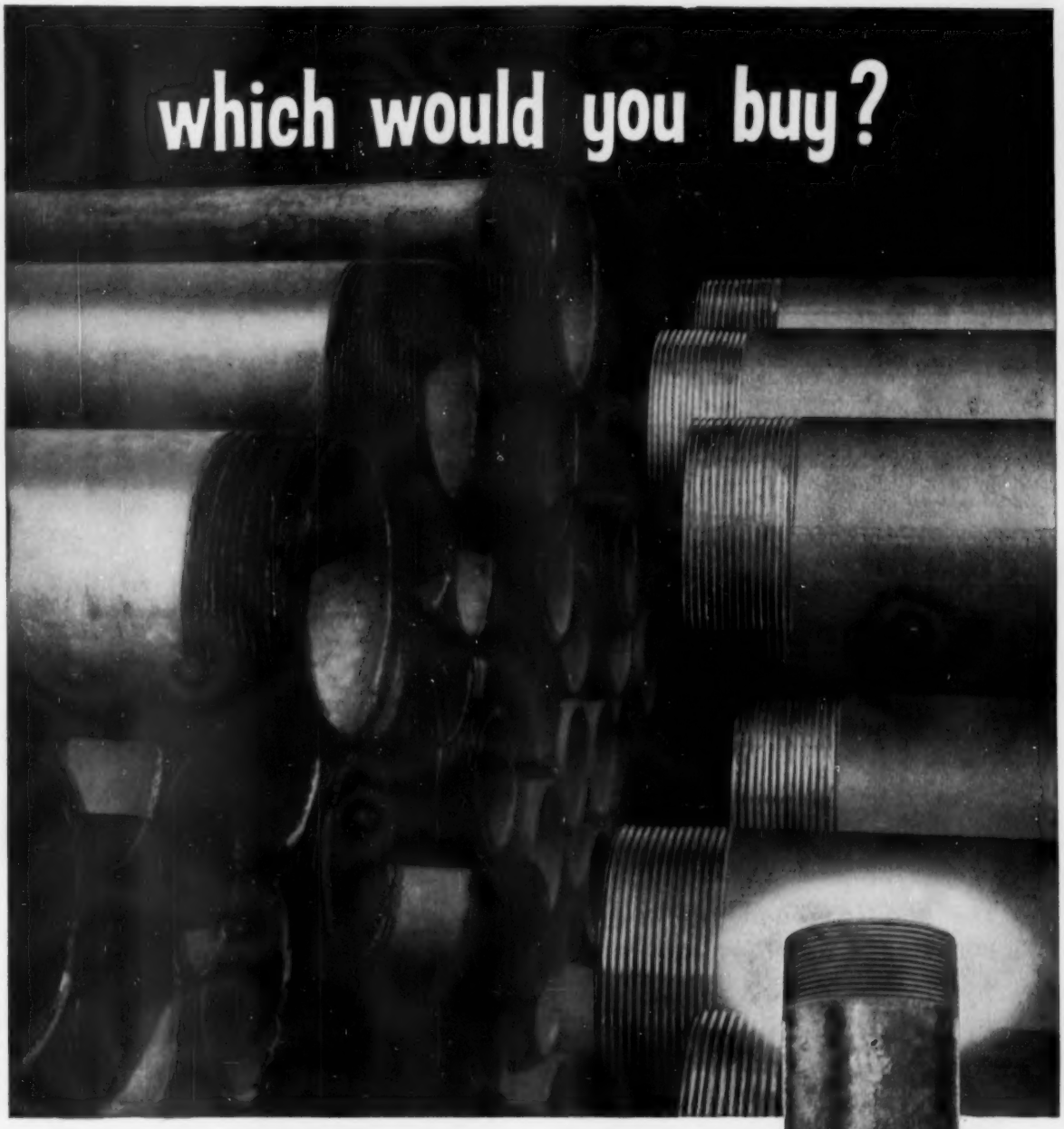
IT PAYS TO STANDARDIZE ON THE AMERICAN BLOWER LINE!

- **Attic Fans** for comfort cooling at low cost in homes, apartments, hotels. Ratings certified; vertical or horizontal models.
- **Aeropel Home Ventilators** for kitchen use, or small commercial ventilating jobs. Attractive design; quiet, easy to install.
- **Ventura Fans** for efficient commercial and industrial ventilation; propeller type; 10 to 72 inches. Certified ratings.
- **Utility Sets** for general supply or exhaust duty. Ratings certified; self contained. Sirocco wheels, 3 to 36 inches.

AMERICAN BLOWER

Division of American-Standard

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO



rusty conduit threads or
Pittsburgh Standard Hot-Dip Galvanized Threads

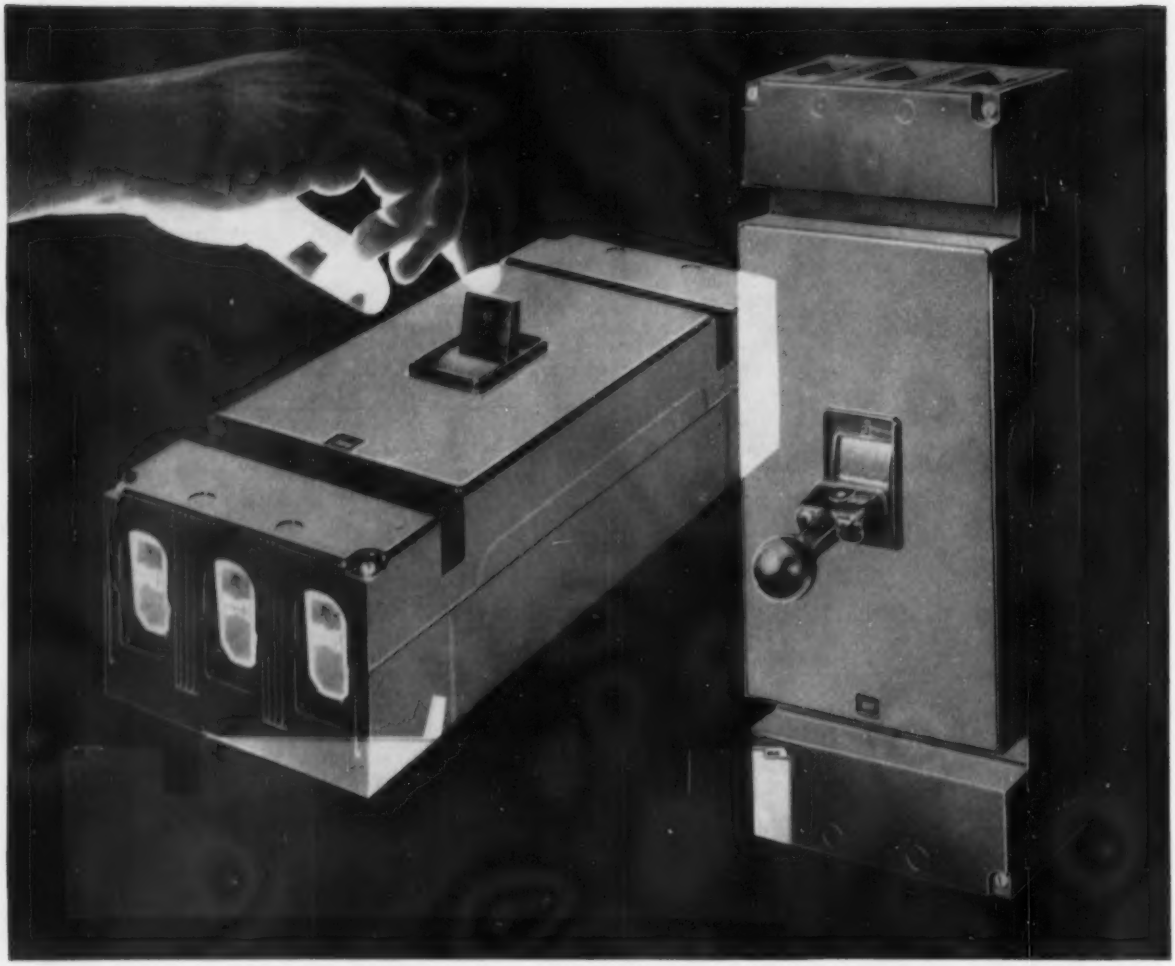
Did you know that *only* Pittsburgh Standard gives you . . . in production quantities . . . hot-dip galvanized conduit with galvanized threads? Did you know that there is *no extra cost* for this conduit with threads that stay *rust-free* on the job-site or in storage? Did you know that you can get delivery and pricing information on this major innovation *today* from the Pittsburgh Standard Sales Control Center? Call your nearest Pittsburgh Standard wholesaler, or write us for his address . . . Pittsburgh Standard Conduit Co., 61 Bridge St., Pittsburgh 23, Pa.

PLANTS AT MORRISVILLE & ETNA, PA.

PITTSBURGH STANDARD CONDUIT CO.

50 yrs

RIGID STEEL CONDUIT • ELECTRICAL METALLIC TUBING • ELBOWS • COUPLINGS • FITTINGS



The Westinghouse Type M—only fully rated 800-ampere, molded-case circuit breaker . . .

Saves 3/4 cost of larger devices

Over a year of customer use, as an alternative to larger 800-ampere protective devices, has proved the economical advantage of the Westinghouse Type M AB De-ion® circuit breaker.

Whether you use it singly enclosed or in a switchboard, you'll find it can save ¾ the cost of a larger air circuit breaker. Space or mounting economies may run the savings even higher—such as the use of this design in building compact distribution panelboards.

Though the smallest device of its rating, the new model will carry its full current rating in normal ambients even when enclosed—something other thermal devices cannot do. This feature of ambient compensation is useful in applications where standard units might unduly penalize system capacities. Both the Westinghouse *true 800-ampere* alternate and the standard thermal magnetic trip types are U.L. listed.

You owe it to yourself to get all the facts on the Westinghouse Type M circuit breaker. Get 'em today from your local Westinghouse sales office—or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-30214

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

ELECTRICAL CONSTRUCTION AND MAINTENANCE

55th Year—June • 1956

Basic Heating Design

Approval of a report on Electric House Heating by NEMA as "Authorized Engineering Information" (NEMA Pub. No. HE 1-1956) is an important milestone in the progress of electric space heating. A representative group of the leading manufacturers of electric heating equipment has undertaken the task of organizing basic design and installation information for the industry applicable to all types of electric resistance devices employed in residential space heating. It is expected to be particularly useful to electrical contractors.

The information is not original, nor was it intended to be. Such data have been published by individual manufacturers in their own instruction bulletins. Reports, similar in substance, have appeared in this magazine. But the new report lays down a foundation of essential and authoritative technical data, acceptable to the industry at large, as a base upon which to develop what is bound to become a growing technology.

Significant, too, is the emphasis in the report on adequate wiring and effective thermal insulation. The capacity of any resistance heating device is critically dependent upon the supply voltage at its terminals. The installed capacity required and the operating cost are determined by the heat loss which can usually be controlled to advantage by practical insulating methods. The report recognizes that both wiring and insulation are essential considerations in the application of electric space heating.

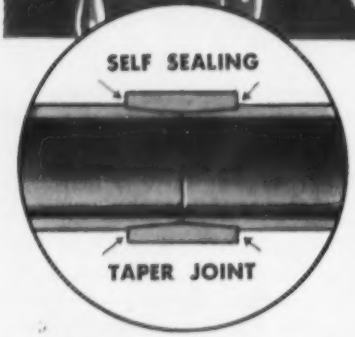
It is to be hoped that there may be beneficial by-products. The development of the electric space heating market has been carried largely by heating equipment manufacturers, distributors and electrical contractors. Notable successes have been achieved where utilities have actively helped the cause and insisted upon sound and economical application engineering. Acceptable authoritative basic design data under NEMA auspices ought to encourage a lot more of this kind of industry cooperation.

What with wide variations in climate, construction, fuel costs and electric rates over the country, the economics and adaptability of electricity for space heating involves judgments which must be made by the contractor on an individual basis for most applications. Excellent equipment is available. Good design and application data are reliable and, properly used, can give reasonably accurate estimates of performance and operating cost.

Practical technology to support sound market development is at hand. The electric heating equipment manufacturers have made a responsible and constructive contribution. Orderly progress today toward well designed electric space heating installations is building significant benefits for the future business of all segments of the electrical industry.

Wm. T. Stuart

WATERTIGHT!



Orangeburg Fibre Conduit Prolongs Cable Life

Keep out corrosive ground waters, and you prolong the life of underground cables, say utility engineers!

Why? Because ground waters containing corrosive elements derived from the soil and concrete encasement attack cable sheath and shorten cable life. Orangeburg's impermeable wall and self-sealing Taper-Sleeve Joint shed them *"like water off a duck's back."* You get maximum protection with Orangeburg.

Orangeburg protects cables in many other ways. Smooth bore, low co-efficient of friction reduce incidence of abrasion. Its material is strong, tough, resilient, durable.

No other conduit is easier to install

Light, 8-foot lengths and a complete line of bends and fittings speed installation. Taper-Sleeve Joints tap water-tight in a jiffy. Orangeburg lays faster and at lower cost than any other type of conduit.

Orangeburg Fibre Conduit has prolonged cable life at minimum expense for utilities, municipalities and industry since 1893.

Distributed by Graybar Electric Company and by General Electric Supply Company. Branches and stocks in principal cities.

WRITE DEPT. EC-66 FOR CAT. 52

ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. West Coast Plant, Newark, Calif.

ORANGEBURG®

FIBRE CONDUIT

Unions Define Ceiling Jurisdiction

IBEW and UBCJA reach agreement on installation and erection jurisdiction of luminous and acoustical suspended ceilings.

LIGHTING progress over the past few years has included a trend to lighting systems using large-area, low-brightness diffusing panels recessed flush in the ceiling. These diffusing panels vary in size all the way from 2-ft-sq units to continuous runs of 36-in.-wide panels which are installed side by side and cover the entire ceiling, wall-to-wall. These panels replace areas of the usual suspended structural ceiling in which they are recessed, equal to their own size. This trend has resulted in a wide variety of equipment designs, and in many application and installation techniques, so that it has been difficult to decide whether certain installation work should be done by electricians or by carpenters. In consequence, jurisdictional disputes have popped up from time to time in recent months.

By tradition, lighting systems have been installed by electricians, and structural ceilings have been erected by carpenters. Following this tradition in concept, an eight-man committee has worked out an agreement which clarifies and settles the jurisdictional question on most of the many types of installations being encountered in practice. The agreement, published here for the general information of the industry, spells out the details in four paragraphs and is supplemented by detailed drawings which serve as a guide to interpretation of the paragraphs. The agreement was signed by IBEW International President Gordon M. Freeman and UBCJA General President M. A. Hutcheson to take effect on February 1, 1956, and to remain in force for two years. The drawings are presented here in two colors to simplify their analysis.

Agreement

Agreement entered into by and between the International Brotherhood of Electrical Workers and the United Brotherhood of Carpenters and Joiners of America.

The object of this agreement is to prevent jurisdictional disputes between the parties hereto with respect to the installation and erection of luminous and acoustical suspended ceilings.

To achieve this object, the parties hereto agree as follows:

1. The installation of typical suspended acoustical ceilings shall be the work of members of the United Brotherhood of Carpenters and Joiners of America.
2. When electric fixtures are used such as All-Brite (Arealiter) or Day-Brite (Mobilex), or other types of fixtures which fit into a grid system: The grid systems supporting acoustical tile and electrical fixtures shall be installed by Carpenters providing parallel tees at two sides of light fixtures support acoustical tile. If additional supports are required for lighting fixtures, they shall be installed by Electricians. Electricians shall install all tees and hangers which support lighting fixtures only. The Electricians shall mechanically secure and ground the fixtures.
3. When the electric fixture is suspended from the ceiling which in turn forms part of the grid system; examples, Taylor Ceilings, United Lighting and Ceilings Company, and Drive Lok (with electrical raceway built in), Electricians shall install all supporting hangers, install electric fixtures, cross members and wall angle. Carpenters shall install all the acoustical materials therein.
4. Where the electrical fixture is fastened to the basic ceiling and the light diffuser is suspended on a grid system, Electricians shall install the electric fixtures, the grid system, the diffusing panels, hangers and wall angles necessary to hold the diffusing panels and grid in place. Where acoustical borders and/or fields are used, Carpenters shall install the acoustical tile and such wall angles and/or hangers as are necessary to support the acoustical border or field. Examples: (Wakefield, Benjaman, Sylvania, Acusti-Luminous Ceilings, Smithcraft Lighting Division, and Daylight Luminous Ceilings).

It is the intention of the parties to this agreement to allow the basic design and practical procedure of installation to determine which Trade installs the common hanger and supporting member holding the light diffuser or fixture and acoustical material.

This agreement shall take effect on February 1, 1956, and shall remain in full force for two years.

Unless notice of a desire to change or modify this agreement is served by one party on the other sixty (60) days prior to its termination date, it shall automatically continue in effect for another period of two years.

UNITED BROTHERHOOD OF CARPENTERS AND JOINERS OF AMERICA

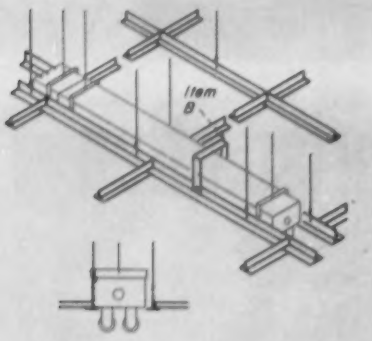
M. A. Hutcheson

General President

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

Gordon M. Freeman

International President

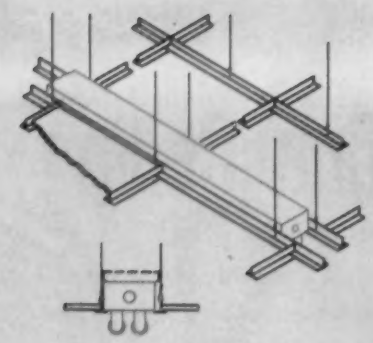


Fixtures Independently Supported

Drawing No. 1 Par. No. 2

Typical Installation

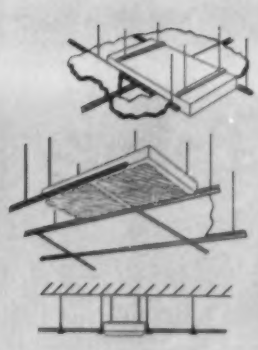
1. Electrical fixtures independent of grid system. Hanger wires for fixtures, and fixtures, by electricians.
2. **Complete grid system—including all hanger wires for all tee bars—by carpenters. Special spacer bar—Item B—locking grid system together—by carpenters.**



Fixtures Supported By Tees

Drawing No. 1A Par. No. 2

If additional supports are required for lighting fixtures, they shall be installed by electricians.

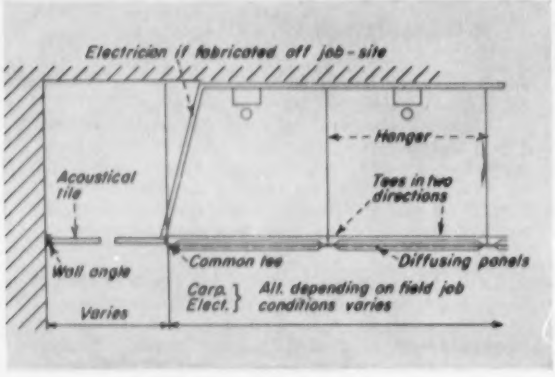


Fixtures Independently Supported

Drawing No. 2 Par. No. 2

Elect.—Lighting fixtures between tee bars. Fixtures independently supported from structure above.

Carp.—Tee bar grid system suspended from structure above and all acoustic tile.

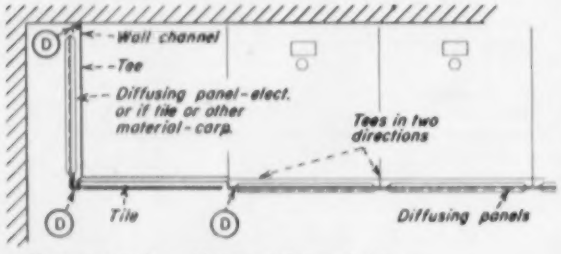


Luminous with Acoustical Border or Field

Drawing No. 6 Par. No. 4

Carpenters—When Gypsum board, glass fibre or other material is fabricated and assembled on job-site.

Electricians—If fabricated off job-site.



Diffusing Panels Alternate Acoustical or Diffusing Plastic Drop Trim

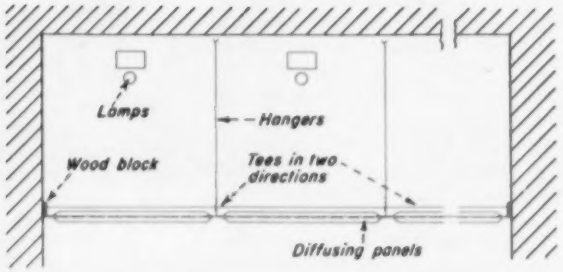
Drawing No. 10 Par. No. 4

A—If all diffusing panels—Elect. to install complete assembly.

B—If all tile border—Carp. to install up to common tee.

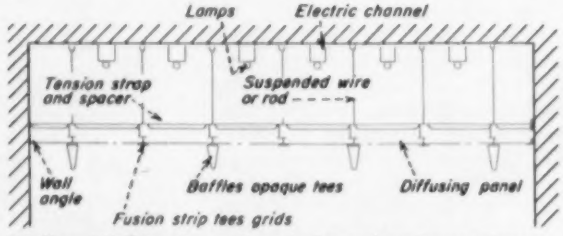
C—If combination panels/diffusers (Par. No. 4 bracketed portion) common tees

D—Or other angles—logical procedure electrician or carpenter.



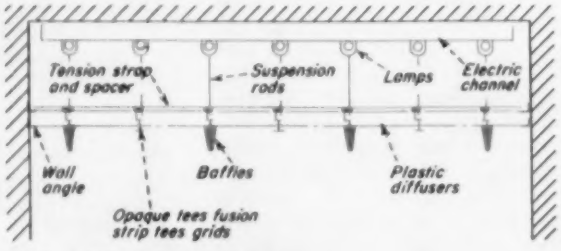
Wall-to-Wall Luminous Area

Drawing No. 7 Par. No. 4



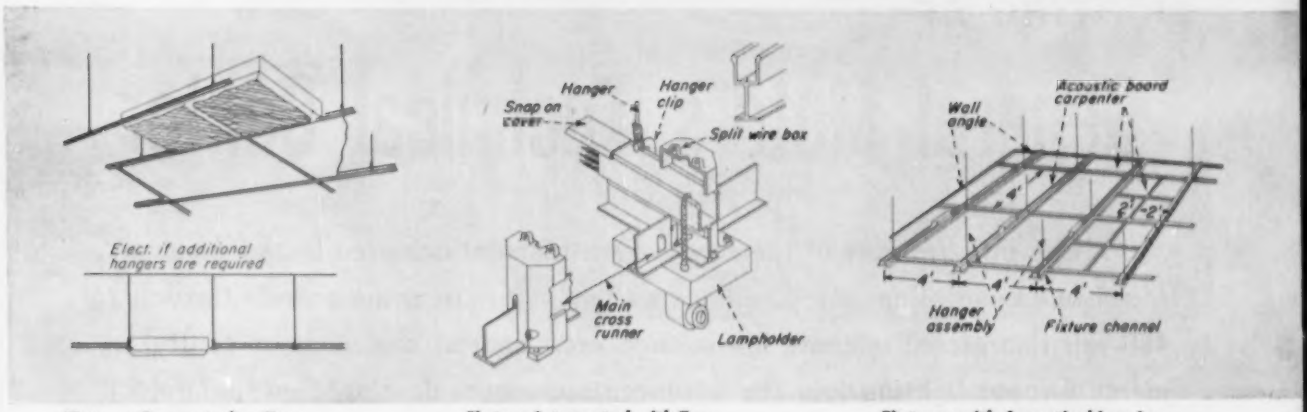
Wall-to-Wall Luminous Area Independent Suspensions

Drawing No. 11 Par. No. 4



Wall-to-Wall Luminous Area Integrated with Electrical Channel

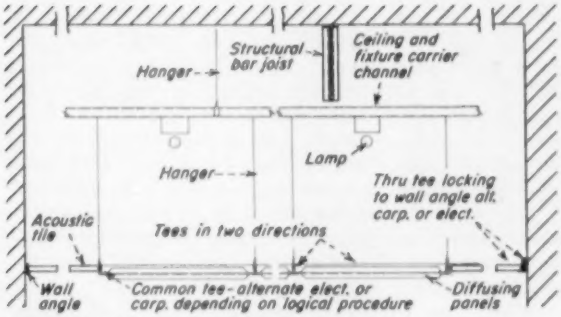
Drawing No. 14 Par. No. 4



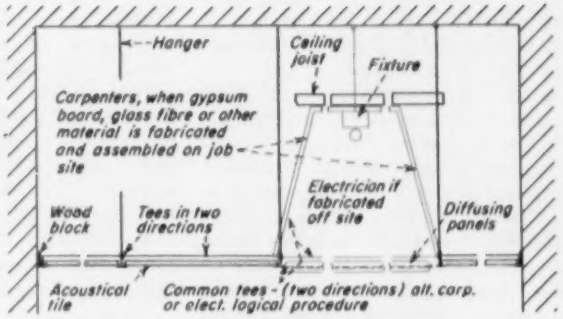
Fixtures Supported on Tees
Drawing No. 3 Par. No. 2
Carpenter except if additional support for lighting fixtures then electricians.

Fixture Integrated with Tee
Drawing No. 4 Par. No. 3
As a fixture—Comes under par. No. 3
As a raceway—Not involved in this agreement.

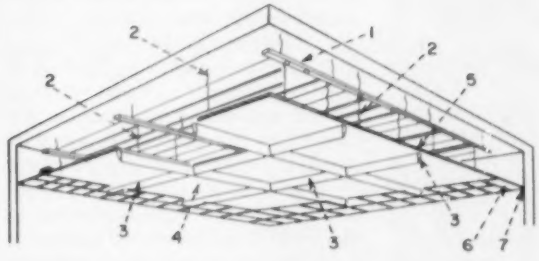
Fixtures with Acoustical Lay-in
Drawing No. 5 Par. No. 3


Hanger
Structural bar joist
Ceiling and fixture carrier channel
Lamp
Thru tee locking to wall angle alt. carp. or elect.
Acoustic tile
Tees in two directions
Wall angle
Common tee - alternate elect. or carp. depending on logical procedure
Diffusing panels

Acoustic Border or Field & with Through Tees
Drawing No. 8 Par. No. 4

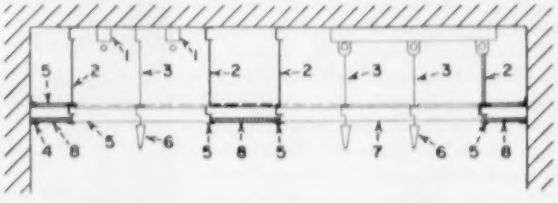

Hanger
Ceiling joist
Fixture
Carpenters, when gypsum board, glass fibre or other material is fabricated and assembled on job site
Electrician if fabricated off site
Wood block
Tees in two directions
Diffusing panels
Acoustical tile
Common tees - (two directions) alt. carp. or elect. logical procedure

Small Island of Light in Larger Acoustical Ceiling
Drawing No. 9 Par. No. 4



Island Diffusers
Drawing No. 12 Par. No. 4

1— Electrical channel	Electricians
2— Channel/mid supports	"
3— Baffle and/or tee grid	"
4— Plastic diffusing panels	"
5— Perimeter closure	"
6—Acoustical panel or furred area	Carpenters
7—Wall angle	"



Partial Coverage Integrated or Independent Systems
Drawing No. 13 Par. No. 4

1. Electric channels & lamps	Electricians
2. Common hangers—To be assigned with tees alternate	Elect. or Carpenters
3. Luminous panel hangers	Electricians
4. Wall angles	Carpenters
5. Common tees (Alt. electrician bracketed Par. 4)	
a. Designed to match & tie in with acoustical	Carpenters
b. Designed to match and tie in with plastic	Electricians
6. Baffles and/or fusion strip tees of opaque tees	Electricians
7. Diffusing panels	Electricians
8. Acoustical tile	Carpenters
9. Tension strap spacer	Electricians

LIGHTING AT

General Motors Technical Center

. . . . is an integral part of the creative environment achieved by the designers. Multi-functional illuminated ceilings with modular circuiting provide flexibility. 480-volt fluorescent systems, low-voltage area control and dimmer control of mercury-vapor lighting join the advanced techniques developed on the project.

OFFICIAL dedication last month of the General Motors Technical Center in Warren, Mich., brought to a close a 7-year period of construction, design and lighting surprises wherein an entirely new concept of building assembly from prefabricated parts and an expansion of modular flexibility were developed. Situated on a 330-acre site some 12 miles north of Detroit, this large modern research facility comprises 25 buildings located in a campus-like setting around a 22-acre artificial lake complete with two fountains and four islands of weeping willow trees. Here is the workshop of five General Motors central staff organizations: Research, Engineering, Process Development, Styling, and a Service Center. Structures range from gatehouses to large laboratory, office and shop buildings—all designed along simple, modern lines.

To the layman, the Center is an appealing, eye-catching group of colorful two and three-story buildings with curtain-wall glass sides and brightly colored glazed brick end-walls. Acres of lawn, with more than 13,000 trees and some 60,000 plants and shrubs achieve an atmosphere of quiet spaciousness with plenty of sunlight and clean country air.

To the 4,000 men and women who daily explore the future within its confines, the Center is a unified, beautiful environment in which they can give free rein to their intelligence and skills. Here, they are unhampered by distracting city noises and the physiological and psychological obstacles often prevalent in small, poorly lighted work areas.

To General Motors executives, project architect Eero Saarinen & Associates (Bloomfield Hills, Mich.), and architect-engineers, Smith, Hinchman and Grylls, Inc. (Detroit), the Center represents the best possible facilities for industrial research in science and technology. It fulfills all the functional requirements, yet achieves an esthetic freedom seldom found in office and shop buildings. It expresses the forward-looking industrial character with buildings and facilities which will look as modern tomorrow as today.

To Bryant & Detwiller Company (Detroit), the general contractor, and the building construction industry, the Center meant even more. Throughout construction, the multi-million dollar facility became one long project in construction research. Out of it came techniques never before dreamed of. Buildings rose in assembly line fashion.

TYPICAL UNIT SUBSTATIONS in the various buildings contain two transformers of identical rating and secondary bus tie so electrical service can be maintained from either one in case of an emergency.

Conventional masonry walls were replaced by 2-in. thick, sandwich-type, prefabricated, porcelain-enamel steel wall panels with equivalent heat insulating qualities. Solid panels and glass curtain-walls are mounted in prefabricated aluminum extrusion frames 10 ft wide and one-story high. Panels are held in place by a neoprene gasket weather seal and a "zipper piece" neoprene filler between joints.

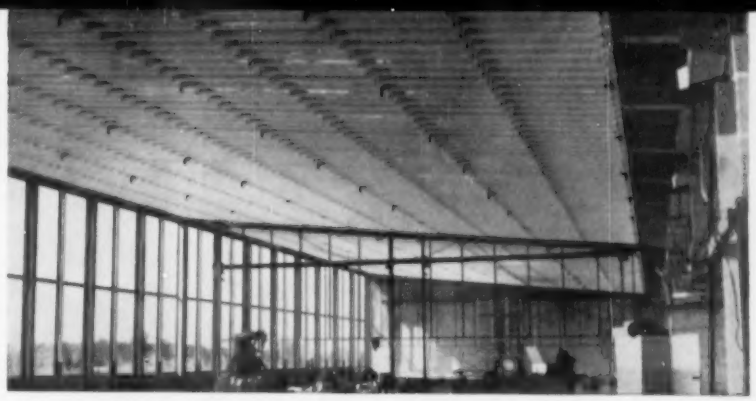
The modular system of standardized dimensions was carried throughout the design. The 5-ft module was applied to steel construction, wall panels, partitions, furniture, lighting systems, heating, ventilating, air conditioning and sprinkler systems. If desired, whole sections of glass-curtain-wall can be replaced by solid panels. Entire floors can be rearranged, with utilities reconnected, in a minimum of time. All of these construction features had a direct bearing on electrical installation techniques.

From the standpoint of electrical system design, the Center produced many "firsts". Among them: 480-volt, 3-phase fluorescent lighting; 24-volt, large-area remote control of lighting circuits as a standard; concealed trolley-type bus duct for modular circuiting of lighting; large area installations of multi-functional illuminated ceilings with acoustic baffles; 5-foot square plastic pan diffusing panels in modular pattern for over-all ceiling lighting.

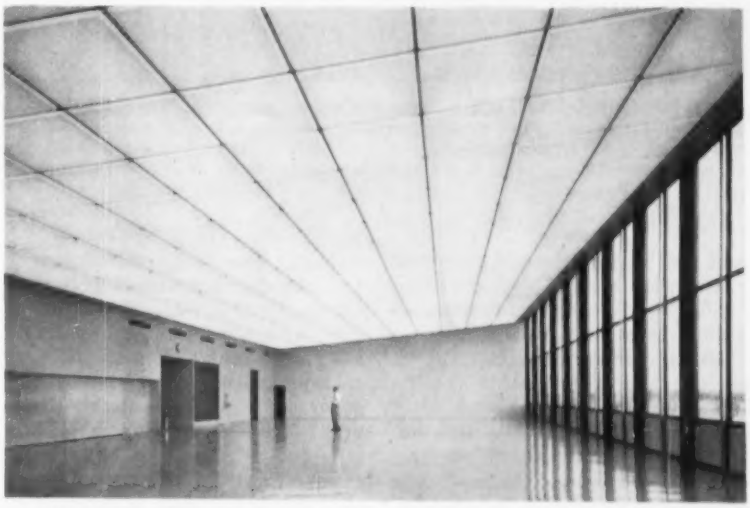
In a number of cases, buildings were specifically designed to conform to lighting requirements.

Electrical contractors readily adapted themselves to the new concepts and helped solve the many installation problems which normally arise on any construction project. Among the Detroit firms working at the Center were the following: Brooker Electric Co., Inc.; Gray Electric Co., Inc.; The John H. Busby Co.; W. D. Gale, Inc.; Harlan Electric Co.; Hydon-Brand Electric Co.; J. Livingston & Co.; Motor City Electric Co.; and Southeastern Electric Co., Inc.

This pioneering research on building materials, lighting equipment and construction techniques was undertaken in unique cooperation between General Motors, the architects, engineers, equipment manufacturers and contractors. Out of it has come concepts which reportedly have advanced many phases of the construction industry some ten years. A number of these new developments have since been used in other installations and may well become a part of the construction industry's standard practice.



LAMPS COVER ENTIRE ceiling in Styling Studios. Spacing is 15 inches. Black dots in photo are sprinkler connections. Ceiling height varies from 20 to 25 feet.



DIFFUSING PLEXIGLAS PANS supported by an unobstrusive grid transform ceiling into one huge, low-brightness light source. Maintained footcandle intensity in area is 94. Room has acoustic-tile walls.

Electrical Distribution

Statistics indicate that more than 21,000 kw of electrical energy are used every hour at the Technical Center. To provide adequate service for a load of this magnitude, a well designed electrical distribution system was installed.

Primary service, consisting of two 24,000-volt overhead lines, is furnished by the Detroit Edison Company to the Technical Center proper. From each of these lines, a 24-kv, 350MCM paper and lead-covered cable goes underground at the property line and terminates in a main substation at the power house in the Service Section building. Edison transformers at the main substation consist of two 10,000-kva, 24,000/4800-volt, 60-cycle, delta-connected transformers with voltage regulators guaranteeing 2% voltage regulation.

Electrical distribution to the various buildings is at the 4800-volt level and originates at switching cubicles in the power house. The 4800-volt, 150,000-kva interrupting capacity switchgear consists of two main breakers, one tie-breaker, utility metering panel, seven lighting feeder breakers and six power feeder breakers. There is one spare position and space allotment for five future breakers. The station bus tie key is interlocked to prevent closing of more than the two main breakers or one main breaker and the tie breaker at any given time.

From the main substation, 450MCM, 4800-volt cables go through an underground duct system to unit substations in the various buildings. The duct system provides for growth up to a maximum of 20 power or lighting circuits. One lighting and one power cable go to each group of buildings: Styling, Engineering, Research, Process Development, Metallurgical, etc. Circuits terminate in double-ended unit substations, one transformer being for power and one for lighting.

All distribution transformers are 4800-volt delta primary and 480/277-volt wye secondary. The two transformers in each unit substation are identical in kva capacity and have a tie-breaker on their secondary sides. With this arrangement, lighting can normally be kept separate from power. In the event of a power failure on either unit, or the feeder cable, the secondary tie breaker can be closed to maintain both lighting and power service with the remaining transformer. Thus, each group of buildings, in effect, has a dual feeder system.

All fluorescent lighting is fed at either 480 volts or 277 volts. Incandescent lighting equipment and receptacles are fed from utility panels distributed throughout the building and supplied from 480/208/120-volt transformers. When these units are 37½ kva and smaller they are fed from the lighting bus.

Unit substation transformers for both power and lighting are limited to a maximum of 1500 kva. This keeps feeder lengths to a minimum

MULTI-FUNCTIONAL CEILING in Research Building incorporates 5-ft. Plexiglas diffuser modules, wedge-shaped acoustic baffles and combined air conditioning and sprinkler outlets. An intensity of 110 footcandles is maintained in this library.

BAFFLE CEILING in the Engineering Administration building maintains the standard 5-foot module. Cylinders at junction house sprinkler pipes, air conditioning outlets or support partitions. Perforated reflector pans go over lamps.

and switchgear interrupting capacity within the 50,000-kva class. It also permits breaker interchangeability between substations.

Except for the voltages involved, secondary distribution for lighting within the various buildings is of the conventional type with distribution panels in stair and corridor locations. Because of the panel-type wall construction and the modular steel office partitions, all electrical circuits are either in the ceiling areas or in underfloor duct systems.

Lighting Requirements

The architects and engineers relied heavily on lighting to achieve the working conditions most conducive to creative activity. Better than 95% of all lighting in the Center is custom built. Most of it was specially designed to solve specific visual problems and to meet the flexibility requirements of modular construction. Only in shop areas and a few other places are standard fixtures used.

Large area, low-brightness, high-intensity illumination was a requisite in most of the buildings—particularly in drafting room areas. The prime goal was to secure comfortable, shadowless lighting on the work surface. The solution was to use multiple, low-brightness light sources in an overall ceiling pattern with the 5-ft, low-brightness 40-watt fluorescent tube to conform to the 5-ft. module scheme. In general, lighting was designed to produce the following maintained footcandle intensities: large areas—100 to 120; drafting rooms, minimum of 100; office areas, 50; lobbies and corridors, 30; styling studios, 95; color matching room, from 90 general to 250 on matching table; display auditorium, up to 140. Variations of the illuminated ceiling in the various buildings included: 5-ft sq formed plastic pan diffusers; honeycomb louver-all diffusers; corrugated plastic diffusers and a deep-baffled ceiling with low-brightness tubes.

Multi-Functional Ceilings

Lighting research carried on throughout the construction of the Technical Center led to the development of the multi-functional ceiling which incorporates lighting, sound control, air-conditioning outlets and sprinkler outlets in a 5-ft modular pattern.

Initial step in the evolution of this type of ceiling was the development of a 5-ft sq plastic pan diffuser unit for lighting the three floors of the Research Laboratory at the Center. Based on an original design and mock-up by G. M. Styling personnel, The Wakefield Company developed a 5-ft module fixture "packaged" with three 5-ft, 40-watt, T-17, cool white, fluorescent lamps mounted on 15-in. centers at right angles to two supporting electrical channels with an interconnecting conduit spacer. The unit features a swing-down, hinged, 5-ft sq, translucent Plexiglas diffusing panel with a matte finish on the under side. Receiving grid channels, 3-in wide, support the Plexiglas panels and provide a mounting for wedge-shaped acoustical baffles, sprinkler outlets, air conditioning outlets and movable partitions. Now known as Wakefield Sigma-Plex, this multifunctional ceiling system has been installed on other projects.

A variation of this ceiling, without the acoustical baffles, was designed for the high (20-ft to 25-ft) sloping ceilings in the Styling Studios. Here, the lighting problem was to combine low-brightness ceiling lighting with natural lighting from the large window walls in a manner that would eliminate specular reflections and shadows on the cars in the studios. Maximum width of the supporting grid (including aluminum plastic panel frames) was held to 1⅛-in. to minimize grid shadow. The illuminated ceiling ends 2½ ft from the windows and 5 ft from the acoustic-tiled walls; has plastic side panels to eliminate a dark border at wall and ceiling juncture. Sprinkler outlets are installed at all grid intersections. Those not used are capped for future connection.

Maintenance of the plastic-pan modular ceiling has been exceptionally good. Reports are that after more than 18 months of operation, without any maintenance at all,

CORRIDOR LIGHTING at 30-footcandle level is achieved in this modular baffle ceiling by adding plastic diffuser strips to the intermediate baffles with solid panels positioned between the two rows.

COLOR CENTER in Styling Building is illuminated by honeycomb louvered ceiling producing 75 footcandles of general lighting. Room is 80 ft. in diameter, has a color matching room where lighting can be raised to 250 fc.

lighting in the Research Laboratory still produces 100 footcandles. Present plans indicate group lamp replacement on a 2-year schedule with washing of the ceiling at the same time.

The multi-functional ceiling concept was also used in the Engineering Administration building. Here, the basic module is a 9½-in. deep metal baffle which forms the 5-ft sq pattern. At intersections (5-ft 2-in.) of the module baffle, an 8-in. cylinder was installed for air conditioning, sprinklers, wiring raceway to a partition, or partition connection to the baffle. Unused cylinders are capped for future connection to air conditioning duct or sprinkler line taps above.

Either one, two, or three 5-ft, 40-watt, low-brightness (960 foot-lamberts with 2100 lumen output) fluorescent tubes can be mounted in each module. Intermediate 9½-in. deep baffles separate the lamps and provide a 38-degree cutoff. Perforated pan reflectors above the tubes direct the light downward and preformed acoustic board above the pans provides sound conditioning.

Interesting variations are obtained with this type of ceiling. In the large drafting room areas, the open baffle ceiling with three lamps per module is producing an intensity of 120 footcandles after a year's operation. In the executive offices, the same baffle ceiling is used but the lamps are shielded with strips of diffusing plastic and sometimes alternated with bands of acoustic material.

Modular Circuiting

In buildings where an unusual amount of office rearrangement, due to varying development or research programs, is anticipated, a highly flexible branch circuit lighting technique is used. Lighting fixtures in these areas are fed by 3-phase, trolley-type bus duct "branches". The duct is installed in 5-ft lengths with insulated "isolation" couplings at original partition lines. Duct sections are energized by 3-pole contactors connected to the 3-phase 480-volt building panel and controlled by a 25-volt, momentary-contact toggle switch in the office partition wall. Contactors as well as fixtures are connected to the duct by a flexible cord with trolley-duct plug.

If an office partition is moved 5 or 10 ft (and it must be a multiple of 5), the insulated coupling at the original partition line is replaced by a jumper (or continuity coupling). Insertion of an insulating coupling in the duct line at the new partition location completes the shift and all lights on the extended duct section are controlled by the original switch in the enlarged office.

Such flexible circuiting makes it possible to shift office arrangements in a minimum of time. In fact, it has been reported that an entire floor in a 370-ft by 56-ft building with this modular circuiting was rearranged over night.

480-Volt Lighting and Control

All fluorescent lighting throughout the Technical Center is operated either on 480-volts, 3-phase;

COMBINATION LIGHTING fixture and air diffuser is used to light the auditorium in the Manufacturing Development Administration Building. 150-watt PAR 38 lamps are used. Spotlights are 500 and 750-watt units in alcove above ceiling.

or 480/277-volt, 3-phase, 4-wire circuits. In general, all areas using the 5-ft, 40-watt lamps are on the 480-volt, 3-phase system.

Special ballasts were designed for lamp operation on the 480-volt circuits. These are simply choke coils which eliminated use of starters and gave instant start operation. Minimum power factor of these ballasts is in the order of 25%.

Power factor correction, to overcome the low PF of the ballasts, was added to the system by installing standard 5-kva, 3-phase, 480-volt capacitors of the dust-tight, self-discharging type with individual fuse protection. Units are installed singly above the illuminated ceilings, or grouped in banks at the distribution panels depending upon structural conditions. Prior engineering studies proved this method more economical than the use of special high power factor 480-volt ballasts on the thousands of fluorescent lamps involved.

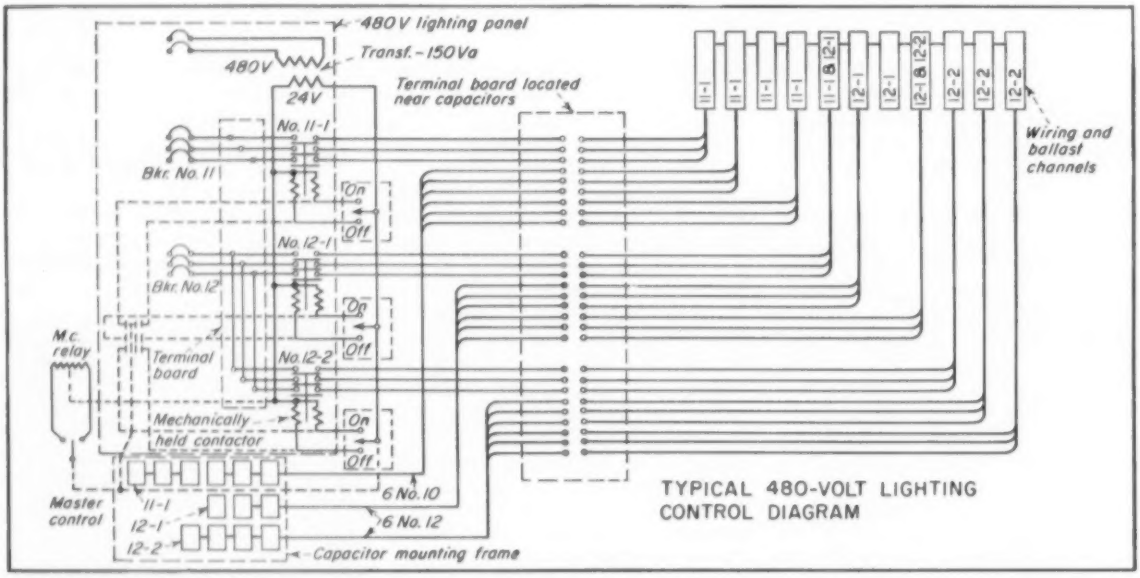
Low-voltage remote control (24 volts) is the standard method of operating the lighting on the 480-volt and 277-volt systems. This applies to individual offices or large areas and is particularly advantageous since narrow metal office and wall partitions provide limited space for switch installations.

In buildings with ample working space above the ceilings, lighting circuits are controlled by a 480-volt, Size O, coil-actuated, mechanically-held, latch-type contactor equipped with a 50-va 480/24-volt control transformer. Where two or more contactors are operated on a single transformer, a 100-va unit is installed. Generally, these contactors are mounted on the roof truss above the ceiling with control cables going to single-pole, momentary-contact toggle switches in office partitions.

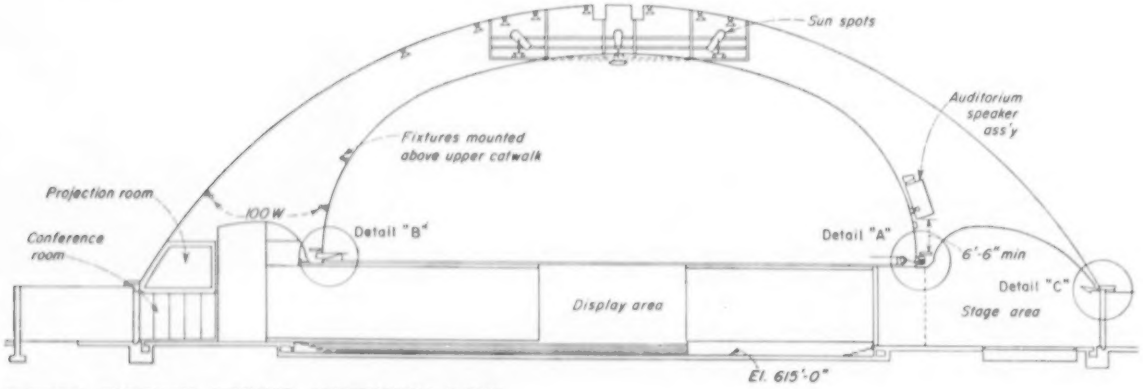
In the Styling Studios, where space above the illuminated ceilings is limited, the control contactors are mounted in a common cabinet with the 480-volt circuit breakers in the building corridors. Zone control is accomplished with remote control toggle switches. In addition, each studio has one or more "master" switches to control all lighting in the area.

Display Auditorium Lighting

The striking, aluminum-clad, steel dome display auditorium in the Styling group is a building that was definitely designed around



TYPICAL CONTROL DIAGRAM for 480-volt, 3-phase lighting with banked capacitor installation and zone plus master switch control on the 24-volt circuit.



SECTION THROUGH STYLING AUDITORIUM DOME

lighting requirements. In fact the center, interior dome is one large lighting fixture 115 ft in diameter and some 42 ft deep. G. M. officials indicated that unless the lighting was "right", the building would be useless, since new model cars are displayed here for inspection and study by executives. Cars are displayed under the main dome and on a 110-ft by 40-ft side stage equipped with its own dome and with three 16-ft diameter turntables.

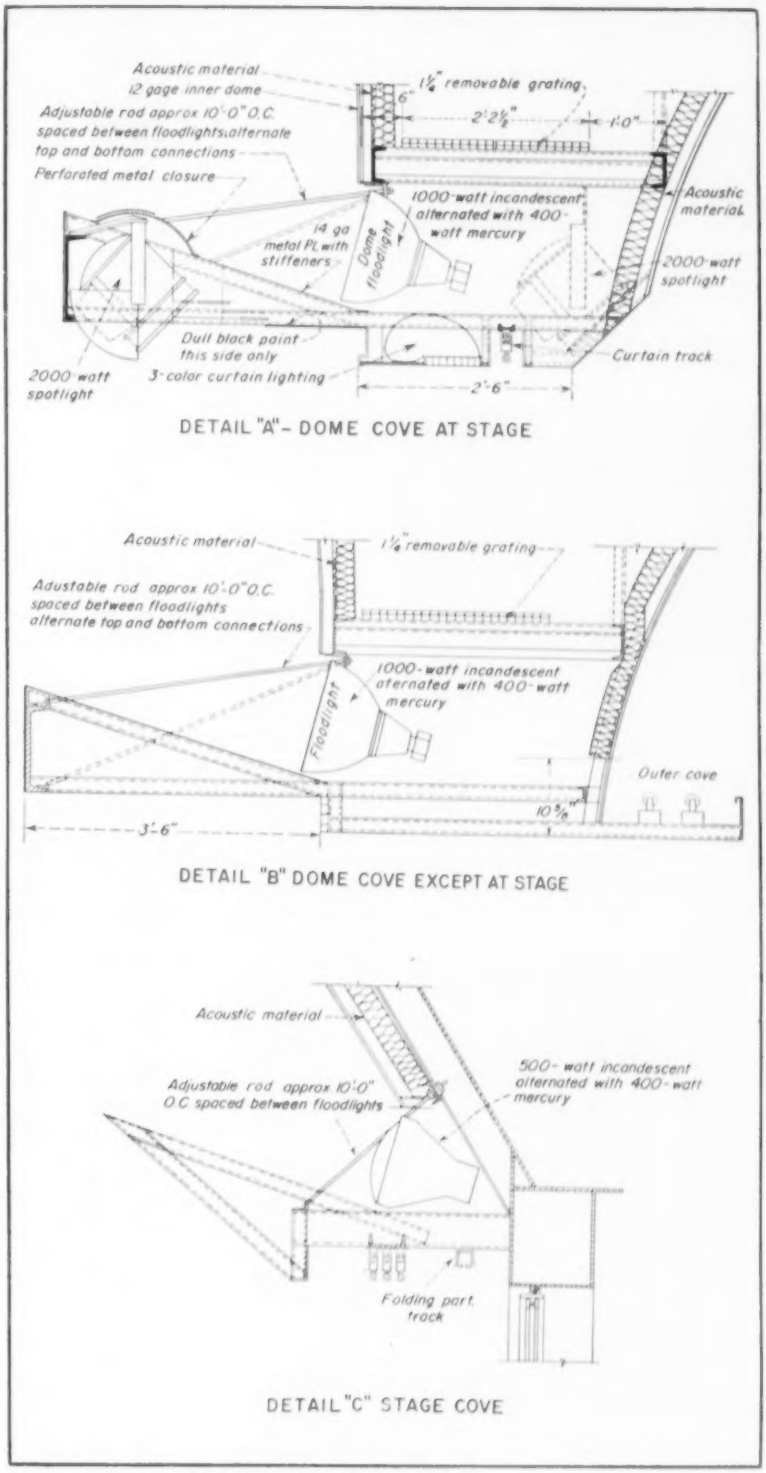
Basically, the lighting problem was this: to simulate ideal lighting conditions (overcast sky) with indirect illumination from an interior dome covered with a perforated acoustic metal skin having a 70% reflection factor. The solution is recognized as one of the architectural technological innovations at the Technical Center.

The desired lighting effect is achieved by concealing a total of 140 1000-watt incandescent floodlights alternated with 140 400-watt mercury-vapor floodlights in a 3-ft. 6-in. cove (with a 15-in. lip) which rings the lower edge of the dome 15 ft above the floor. Angle of focus of all fixtures is 15-degrees above the horizontal. The net result is a smooth light pattern providing 140 footcandles under the dome. The walk around the outer edge of the dome is illuminated by dimmed fluorescent units to produce a halo when dome and stage light are out.

The dome over the 100-ft stage was illuminated in a similar manner. Here a total of 84 500-watt incandescent floods and 42 400-watt mercury-vapor floods, concealed in a rear cove, produce a smooth pattern of approximately 100 footcandles of reflected light on the stage area. As in the large dome, fixtures selected had to have a light curve which would fit the dome curve and physical dimensions which would fit the cramped space of the cove. At the front of the stage a special parabolic reflector trough built into the dome houses the 3-color curtain lights.

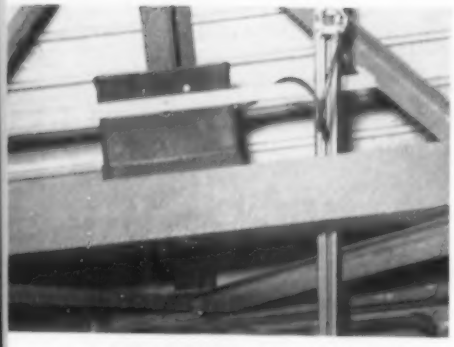
Near the center of the large dome are four openings for 3000-watt, 500,000 to 750,000 beam lumen, adjustable beam, "cannon spots" which can be turned on to represent the sun. These can be controlled either from the stage or projection booth and can be positioned to cover the entire auditorium floor area or highlight a specific display.

Stage spotlighting consists of nine 2000-watt spots concealed un-



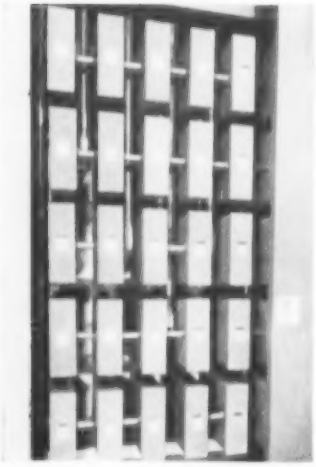
DETAILS OF AUDITORIUM DOME COVE LIGHTING

A—Inner Dome at Front of Stage
B—Inner Dome Except at Stage
C—Stage Dome at Rear of Stage

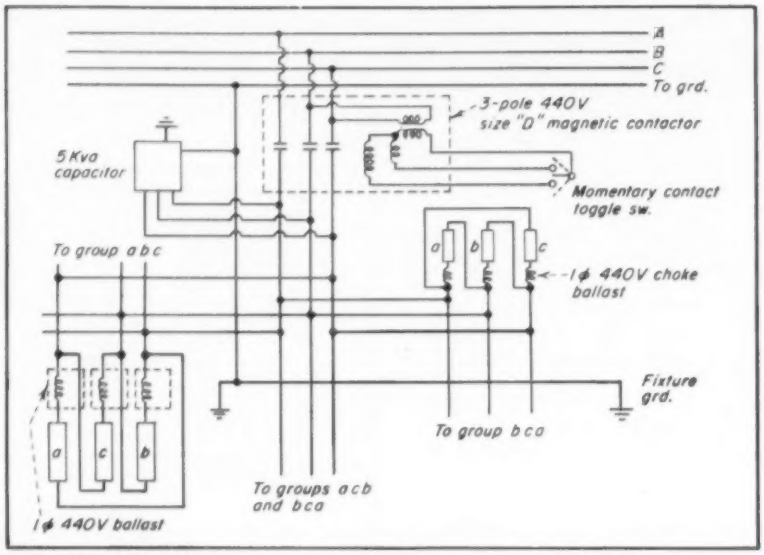


TROLLEY DUCT in five-foot sections with insulated "isolation" couplings feeds 480-volt, 3-phase lighting; facilitates quick change of connections when office modules are changed. Here, a 5-KVA capacitor is plugged into the duct.

SINGLE CONTACTORS for control of 480-volt lighting are mounted above modular ceilings where space permits. This 480-volt, 3-phase, Size 0 unit is cord connected to sectionalized, 480-volt, 3-phase trolley duct lighting circuit.



POWER FACTOR CORRECTION for the 480-volt, 3-phase lighting in the Styling Studios is provided by this bank of 5-KVA units installed in a corridor cabinet. Limited space above the illuminated ceilings required grouped installation.



480-VOLT CIRCUIT diagram for 3-phase lighting with 24-volt control from individual office switch. Single 5-KVA capacitor is in the circuit.

der the dome-cove in front of the stage. They can be positioned to light any one of the three turntables on the stage at any one of three angles best suited to highlight the display.

This is one of the first installations on record where mercury vapor units are dimmer-controlled. Actually the mercury-vapor units are dimmed with the incandescent units until a 55-footcandle level is reached. Below that level, the mercury units will not dim further but drop out in spread groups to produce an effect of evenly mixed mercury and incandescent down to 20 footcandles. Below 20 footcandles, the mercury units are all out and the incandescent dims to blackout both the dome and stage.

Auditorium lighting can be controlled from either of the entrances, the stage, projection booth or conference room entrance. This is accomplished by a take-over switch which shifts the controls to the station in use. Each station is controlled by the same key which unlocks the doors of the main auditorium assuring operation only by authorized personnel.

Exterior Lighting

Outdoor lighting at the Technical Center is functional as well as decorative. Four objectives were achieved by the engineers and consultant Richard Kelly. These are: illumination of building end-walls to accentuate the texture of the colored (crimson, orange, yellow, blue, grey, etc.) glazed brick with a minimum of color reflection; highlighting of tree foliage; illumination of pedestrian walks and inner roads; street lighting of boundary roads and parking lots; and colored lighting of elaborate fountain displays. Mercury-vapor units are used extensively throughout the area to complement the greens of the landscaping.

For end-wall lighting, rows of 500-watt incandescent floodlights on 8-ft 8-in. centers are set in a 3-ft deep concrete pit and cord-connected to weatherproof receptacles. Units provide a narrow light beam to bring out irregularities of the brick. Scalloping effect near wall base is controlled by diagonal and herring-bone louvers built into the steel grating over the pit. Where wall coloring requires it, mercury-vapor floods are used. A total of 197 wall lights are on the project.

The two large fountains in the 22-acre lake and one fountain in a 2½-acre reflecting pond are illuminated. A 130-ft long water-wall fountain, opposite the main entrance to the center, has a double row of water jets between which submersible type white floodlights are installed. A ballet fountain at the northeast corner of the lake is illuminated by a total of 84 submersible colored floodlights ranging in size from 400 to 1000 watts. Fountain operation and the color ballet are controlled by an IBM program system.

ESTIMATING YARD LIGHTING

Some items to look for when estimating yard lighting systems. Plans and specs are not always as specific as they could be in presenting details and variations.

By Ray Ashley
Research and Consulting Engineer
Oak Park, Ill.

PRICING SHEET DATE 6-30-55

JOB OR BLDG: JOB NO. 4850 — LOCATION
BID TO: ORG. NO. 62 — ADDRESS
ARCHT. OR ENGR: YARD LTG. — ADDRESS
PLANS MARKED — SCALE — SPEC. No. — EST. No.
EST. BY — PRICED BY — EXTENSIONS BY — CHECKED BY — S.O. No. — SHEET No. 1

MATERIAL	QUANTITY	MATERIAL UNIT	EXTENSION	LABOR UNIT	EXTENSION
- YARD LIGHTING -				HOURS	
LIGHTING UNITS					
20-FT. STEEL POLES (PRATT Y-2053)	9			6.0	54.0
30-FT. STEEL POLES (PRATT X-3063-20 BASE)	3			12.0	36.0
500 W. OPEN FLOODLIGHTS	9			2.5	22.5
400 W. MERCURY VAPOR OV LUMINAIRES	3			4.0	12.0
400 W. TRANSF. - POLE BASE	3			2.5	7.5
NO. 10 WIRE "AF"	700'			.03	21.0
500 W. INCAND. LAMPS	9			.20	1.8
400 W. M.V. LAMPS	3			.50	1.5
FOUNDATIONS - 18" x 18" x 48"					
DIG HOLES	9			2.5	22.5
CONCRETE PER POLE - 9 CU.FT.	9			3.0	27.0
ANCHOR BOLTS + NUTS - ¾ x 18" GALV.	36			.25	9.0
1" ELBOWS - RIGID GALV.	18			.60	10.8
1" CONDUIT NIPPLES - 24" L.	36			.40	14.4
1" COUPLINGS	36			—	—
1" BUSHINGS	36			—	—
FINISH CONCRETE BASE TOPS	9			.50	4.5
FOUNDATIONS - 24" x 24" x 48"					
DIG HOLES	3			3.0	9.0
CONCRETE PER POLE - 16 CU.FT.	3			3.5	10.5
ANCHOR BOLTS + NUTS - ⅝ x 20" GALV.	12			.25	3.0
1¼" ELBOWS - RIGID GALV.	6			.75	4.5
1¼" CONDUIT NIPPLES - 24" L.	12			.60	7.2
1¼" COUPLINGS	12			—	—
1¼" BUSHINGS	12			—	—
FINISH CONCRETE BASE TOPS	3			.75	2.25
					280.95
SHEET 1 - TOTAL LABOR 281 HOURS					

YARD lighting is usually a side show to the main electrical installation, but the potential hazards make it a branch of the work to be watched. Such hazards range from the possibility of overlooking minor items of labor and material to complete omission.

Architects and engineers commonly treat yard lighting as an individual branch of the electrical work. It is not unusual to find a plan covering the complete installation with specifications in the form of notes.

The plot plan often is used for outside lighting. Water, sewage and other utilities are shown on the same plan. Due to the scale, all work is indicated by fine lines and small symbols. With the maze of lines and symbols one might look at the plan without realizing that there was any lighting included. Jobs of consequence are not often completely overlooked, but there are plenty of plans that invite trouble.

Plot and utility *plans must be*

FIG. 1—Detailed listing of equipment and work phases involved in yard lighting (note foundations) are for benefit of those new to this type of work. Study them carefully. Experienced estimators often simplify the list and combine material and labor in one lump sum. Costs can vary depending on equipment used and working conditions encountered.

examined carefully to determine the amount of electrical work involved. "Electrical Estimating," McGraw-Hill Book Company, has a note in the plan checking section: "Check for Exterior Lighting". Every estimator should have a similar note on his list of items to be checked to be doubly sure they won't be missed.

Among the items of greater consequence likely to be overlooked are the following:

1. Soil Conditions
   a. Rock.
   b. Water.
   c. Frozen ground.
2. Weather Conditions
3. Cluttered Working Spaces
4. Incidental Requirements:
   a. Conduit under railroads and roads.
   b. Planking over cable in trenches.
   c. Sand over cable in trenches.
   d. Foundations for poles.
   e. Time for adjusting floodlights.
   f. Painting.

For the benefit of those not regularly in contact with yard lighting some of the pitfalls will be elaborated on.

Watch for these Hazards

Soil Conditions—The estimators most likely to get into trouble due to soil conditions are those regularly engaged in work where the soil is what might be called the "farm" type. It is firm, free from obstructions and easy to work. When figuring work for other localities, possibilities of rock, hardpan and boulders are liable to be overlooked.

Underground Water—This is a hazard that often creeps in unexpectedly. A contractor may work around Chicago for years without giving water a thought. Then, one day he gets a contract for underground work on the lake front and the water problem must be faced. *It involves shoring trenches and pumping water.* Contrasted with the water condition is that of caving in of dry sand in the hot arid areas. On large projects there are usually machines to cope with most soil conditions. But, the contractor with the small job—where special equipment is not justified—must sweat it out.

Weather Conditions—Possibilities of rainy seasons or freezing weather are seldom overlooked by seasoned estimators. When contemplating projects away from home, the estimator must get information on weather along with data for other factors likely to affect working conditions.

If outdoor work is to be carried on during a favorable season of the year, the contractor should include the anticipated completion date in his proposition. Should there be obstacles that cause the work to drag into bad weather, he can substantiate a claim for additional compensation.

Working Spaces—When looking at a plan it is easy to visualize clear working spaces and the job proceeding without interruptions. One does not take such conditions for granted. Fig. 3 shows a simple layout that does not forbode trouble. However, when the contractor should be getting his work in, the clear space may be covered with excavated soil or used for storage. The work may have to be done piecemeal or may be delayed until bad weather sets in.

Overlooking Incidentals

Four causes are largely responsible for items of material and labor being left out of estimates:

1. The type of work is not encountered every day.

PRICING SHEET — DATE 6-30-55

JOB OR BLDG: JOB NO. 4850 — LOCATION:
BID TO: DRG. NO. 62 — ADDRESS:
ARCHT. OR ENG'R: YARD LTG. — ADDRESS:
PLANS MARKED: — SCALE: — SPEC. NO.: — EST. NO.:
EST. BY: — PRICED BY: — EXTENSIONS BY: — CHECKED BY: — S.O. NO.: — SHEET No. 2

MATERIAL	QUANTITY	MATERIAL UNIT	MATERIAL EXTENSION	LABOR UNIT	LABOR EXTENSION
– YARD LIGHTING (CONT.) –				HOURS	
1¼" CONDUIT RIGID GALV.	120'			.08	9.6
1¼" ELBOWS & COUPLINGS	4			.60	2.4
NO. 8 - 2 COND. "RR" WIRE	650'			.06	39.0
NO. 8 3 COND. "RR" WIRE	280'			.07	19.6
NO. 6 - 2 COND. "RR" WIRE	430'			.07	30.1
1¼" LOCKNUTS & BUSHINGS	6			—	—
TRENCHING					
EXCAVATE AND BACKFILL - YARDS	140			2.5	350.0
SAND - YARDS	50			3.0	150.0
2"x8" CREOSOTED PLANKING - LINEAL FEET	1200			.08	96.0
2" SLEEVES - 18" LONG FOR FOUNDATION WALL	4			.25	1.0
PIPE RACK - 4-1¼" COND. 9000	1			2.0	2.0
CONNECT PANEL CIRCUITS	– SEE PANELS –			—	—
LUMBER				—	—
INCIDENTALS					10.0
					709.7
TOTAL LABOR					
SHEET NO. 1 - 281 HOURS					
SHEET NO. 2 - 710 "					
991 HOURS					

FIG. 2—Biggest labor item in this final part of the takeoff is that for trenching and backfill. Excavating labor can vary as much as 200% or more depending upon the soil conditions encountered, the type of men used and the amount of mechanized equipment placed at the mechanics' disposal.

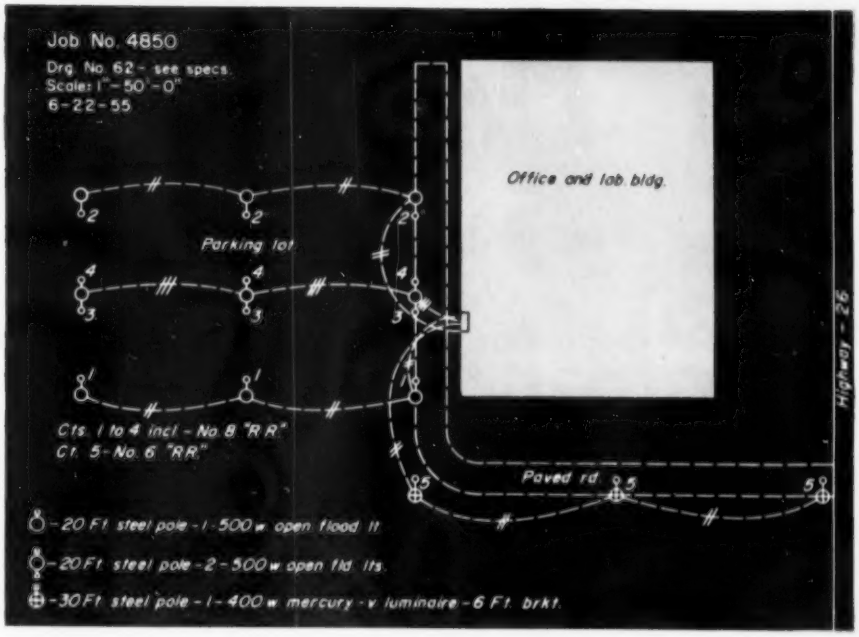

Job No. 4850
Drg. No. 62 - see specs.
Scale: 1"-50'-0"
6-22-55
Office and lab. bldg.
Parking lot
Cts. 1 to 4 incl. - No. 8 "R.R."
Ct. 5 - No. 6 "R.R."
Paved rd.
Highway - 26
-20 Ft. steel pole - 1 - 500 w. open flood lt.
-20 Ft. steel pole - 2 - 500 w. open fld. lts.
-30 Ft. steel pole - 1 - 400 w. mercury - v. luminaire - 6 Ft. brkt.

FIG. 3—A separate plan for yard lighting is a big help to both designer and estimator; eliminates possibility of confusion, errors and omissions. Normally yard lighting is included on general plot plan with other utilities and specifications are frequently in the form of notes. Check carefully soil conditions for trenching.

2. Specifications and types of installations vary greatly.

3. The estimate is rushed because it is the last branch of the work to be figured.

4. Obscurity of symbols.

Items 1 and 2 need no explanation. As for item 3, the last minute rush is common experience among estimators. In spite of all that is done, they regularly run short of time when figuring large projects. The yard lighting, being a minor branch, does not get started until the rush is on. Without ample time for study and take-off, notes and symbols are overlooked and items of material and labor go unlisted.

We have seen many plans with symbols that could be easily overlooked. A drawing may have most of the outside lighting on poles, but on some obscure outlying buildings there will be symbols for floodlights. To make things worse, there are other symbols closely resembling those used for lighting. Besides, when working under pressure, our eyes do not seem to see as well as they should.

Variation in Costs

To assist in the further study of costs, Figs. 1, 2 and 3 have been prepared. We will assume the specification notes to be as follows:

1. All wire to be type "RR" installed 24 in. below grade with 6 in. of sand all around.

2. All wire under roads to be in 1¼-in. rigid galvanized conduit.

3. Lay 2-in. by 8-in. creosoted planking over all wire not in conduit.

4. Foundations for 20-ft poles to be 18-in. by 18-in. by 48-in. and for 30-ft poles, 24-in. by 24-in. by 48-in.

The estimator must use his own knowledge of this type of work for the selection of concrete mix, anchor bolts and other pertinent items.

The hours used in the estimate, Fig. 1, contemplate hand labor by suitable mechanics and favorable working conditions.

With sandy loam or clay soil, the unit costs for trenching (Fig. 2) could vary from 200% to 500% depending on the men and equipment used, working spaces and weather conditions. The work could be done by hand or machine and the workmen could be mechanics or laborers. Spaces may be clear or cluttered and the soil dry, frozen or muddy.

The cost of foundations runs less if "ready-mix" concrete is available. Distribution and setting of poles is a fast moving job when trucks with the proper hoisting equipment are used. With bad working spaces and no special equipment much time can be consumed. Costs of labor for all other items also vary according to conditions and equipment used.

General Practices

Fig. 3 is used as a vehicle and is not offered as a typical example of good practice in yard lighting. As a rule floodlights on buildings are used as far as possible. Obviously the cost is much less than installing lights on poles. When poles and underground wiring are used, the trend is toward the use of parkway cable or "RR" (all rubber) wire instead of wire in conduit. Not all specifications require sand and planking for "RR" wire laid open in the ground. It is good practice, however, to do so.

Plants requiring protective lighting for outlying areas frequently resort to the use of wood poles and overhead wiring. This is especially true where poles are widely spaced.

The preliminary study of plans should include a careful perusal for exterior lighting. In the final rush to get out a bid, one may have to approximate some costs and quantities, but he must not guess at what might be on the plans.

Because a branch of the work is a small part of the job is not necessarily a justified reason for slighting it. Big losses on small jobs wreck small gains on big jobs.

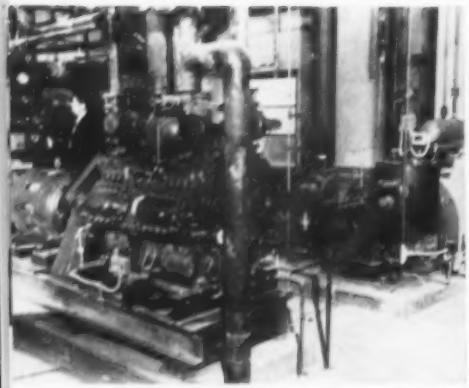


FIG. 1—Reciprocating compressor (foreground) for high stage operation and rotary low stage compressor (right) form one of the three York compound compression heat pump systems in the Heironimus Department store.

HEAT PUMP HEADS NORTH

Multi-stage compression in new heat pump produces practical heating temperatures from below-freezing outside air to bring all-electric, air-source, heating and cooling to colder climates.

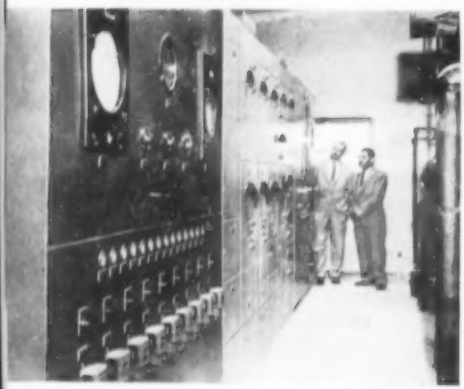


FIG. 2—Fully automatic controls handle all climatic situations. As the weather goes from hot to cold or vice versa, these controls keep the inside temperature at the desired level. In the foreground is the temperature control panel, while the motor control center is contained in the adjacent panel.

FIG. 3—In winter, these units serve as air coolers, while in summer they act as evaporative condensors. During below-freezing weather, specially designed refrigerating coils cool the frigid air to still lower temperatures.

TWO recent heat pump installations—the Heironimus Department Store in Roanoke, Va., with 310 tons, and the Ballinger Building in Philadelphia, Pa., with 60 tons—use a new system which can derive useful heat energy from below-freezing winter air. Automatic controls change the system from summer cooling to heating and to compound operation as outside air temperatures drop below freezing. No supplementary resistance heating is employed. The compound compression principle, applied to the air-source heat pump for the first time by Robert G. Werden of the York Corporation, is expected to be a significant development in year-round air conditioning.

The heat pump works on a principle first conceived by the British scientist Lord Kelvin in 1852. Until a few decades ago, it was used entirely for refrigeration. Within recent years, however, millions of dollars worth of research has gone into the development of practical use of the "hot" portion of the cycle.

Typically a refrigerator or air conditioner employs a compressor, a condenser and an evaporator. The cold evaporator absorbs heat from its surroundings; the hot condenser gives off heat to its surroundings. For cooling a space the evaporator coil is inside; the condenser coil is outside. For heating a space the condenser coil is inside; the evaporator coil, outside.

While many practical heat pump installations have been in full operation for many years, those employing air for the heat source have been limited to milder climates or use supplementary electric resistance heat. The problem has been to design a heat pump which can operate economically with air source temperatures at freezing or below. The new multi-stage development is expected to bring the practical economies of electric heat pumps to more northerly climates.

COEFFICIENT OF PERFORMANCE *

EVAPORATOR TEMPERATURE	1 STAGE WITHOUT SUBCOOLING	1 STAGE WITH SUBCOOLING	2 STAGE WITH INTERCOOLING	2 STAGE WITH SUBCOOLING
-40°	—	—	2.16	2.69
-30°	1.55	1.77	2.34	2.96
-20°	1.95	2.30	2.60	3.25
-10°	2.27	2.73	2.81	3.56

*(COMPRESSORS ONLY)

TABLE I—Multi-stage compression for heat pump improves the coefficient of performance at low evaporator temperatures.

FUNDAMENTALS OF

Shopping Center Electrical Design

PART III—GUIDE TO ECONOMICAL DESIGN.

Electrical costs can range from 70 to 95 cents per sq ft of floor area. What to do to keep costs within budget limits.

By **R. J. Abramson*** *Consulting Engineer, Chicago, Ill.*

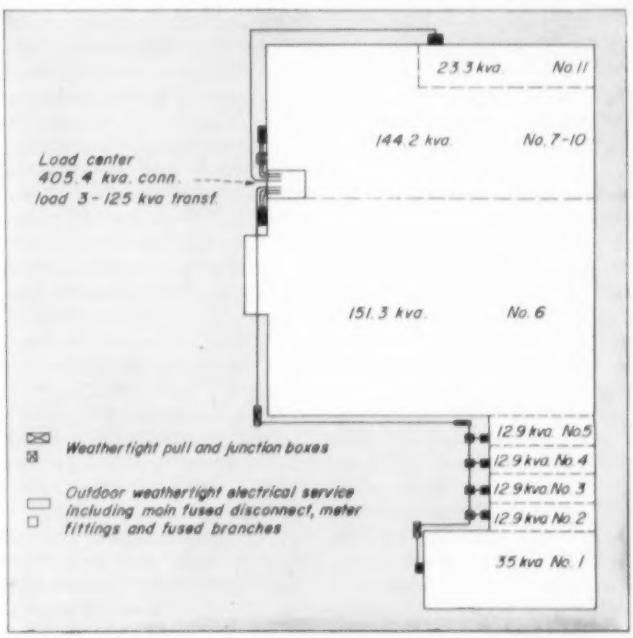
SHOPPING centers now on the drafting board are contemplating numerous added features for the public convenience. These include community rooms, day nurseries, public music and address systems in the malls and parking areas, special festoon lighting and decorative displays. Also included are illuminated outdoor rest areas, with planting, and variations as may interest and keep the community pleased with such a commercial development in their midst.

These added facilities are usually grouped in a common space occupied by the shopping center management and are controlled by them. For instance, the public paging and music systems would be located in the management's space and the program arranged either by the day or connection made to a firm that supplies such music over the telephone system. This system would comprise a number of underground cables extending to the several light poles and speakers mounted thereon for proper distribution as well as speakers located under canopies and, for certain tenants, even installed in the sales areas.

This is not a revenue project as such but adds to the usefulness of the center. It is a public service to the community as a whole since dances, meetings, etc. may be held outdoors, weather permitting.

Community rooms are usually planned for small places with attendant lighting, movie projectors, stage lighting equipment and sundry other devices, utilizing electric power.

Whether or not community rooms are shown in the architectural design of the shopping center, the engineer should make ample provision at the power poles and transformers for the added load. The air conditioning and sundry stage and other lighting for such areas is heavy in wattage for the space used. In general, the shopping center goes beyond a collection of retail stores. It is a community project designed to keep the surrounding neighborhood contented with the retail merchants in their area. It gives them a place to hold community functions and events and to encourage neighborhood participation in the shopping


23.3 kva. No. 11
144.2 kva. No. 7-10
Load center
405.4 kva. conn.
load 3-125 kva transf.
151.3 kva. No. 6
12.9 kva. No. 5
12.9 kva. No. 4
12.9 kva. No. 3
12.9 kva. No. 2
35 kva. No. 1
Weather tight pull and junction boxes
Outdoor weathertight electrical service including main fused disconnect, meter fittings and fused branches

OUTDOOR METERING and disconnect facilities are sometimes required. Here, one building of a group in a shopping center typifies the outdoor T-tap service to individual store units. Conduit feeders are racked on exterior building wall. Load center substations are on roof. All junction boxes, meter fittings and disconnects are weather-tight.

* R. J. Abramson & J. M. Klipp, Mechanical and Electrical Engineers, Chicago, Illinois

AT NIGHT the modern shopping center becomes an oasis of light. Acres of well lighted-off-street parking, dozens of eye-catching signs and a concentration of comfort-conditioned stores beckon families to an evening of shopping pleasure.

center as a joint community effort. To achieve this goal, then, all these aforementioned items become a necessary part of the shopping center from a public relations and good merchandising standpoint.

As a footnote to the above statement, I would like to describe a shopping center now in operation.

Typical Project

One example is Southgate Shopping Center in Maple Heights, Ohio—a suburb of Cleveland. Here we have the usual chain stores, local merchants, and large department store groupings. In fact this project is more in the nature of a regional shopping center. The installation includes mercury vapor parking lights on steel standards, festoon lighting, sign lighting both for the shopping center and fascia lighting and under-canopy sign lighting for the individual tenants. There are directory lane markers for the automobile parking areas, a public address and music system under the canopy. Some of the stores have the management-controlled public address system or the individual public address system as the leasing and tenancy required. In addition, there are the various types of lighting found in chain stores. Most of the tenants are operating air conditioned premises which vary from small package units to large centrifugal machines such as the J. C. Penney store, one of the project tenants.

To provide flexibility, the same general 4-wire, 3-phase system was used with individual service drops to the major tenants and to each building firewall division for groups of smaller tenants. Ample provision for project expansion is made for shopping-center-owned distribution centers. At this center, the owner is buying bulk electricity and retailing the energy through meters to the several tenants. Here provision was made for any forseeable expansion. Two roof-mounted transformer substations illustrate the value of a load center similar to pole-mounted or ground-level transformer banks. The prime object is to shorten service runs and spot the transformers at the load concentration of the particular group of buildings.

Recent load analysis made at the power company's 33kv/4.16kv main transformer pad indicated an overall balanced load and a power factor of approximately 83%. At the grand opening, the entire electrical system was operated at 100%. Although the entire connected load was in operation, at no time was there any evidence of overloading of either the service feeders, the sub-feeders, store panels and sundry other appurtenances that are a part of a complete shopping center. It is apparent, therefore, that even though the finished job ran 15% more in energy than was originally indicated on the leasing plan, the system was able to carry this extra load and still have a reserve capacity for future development which is vital to the growth of any community project such as this.

In our office the use of standardized procedures and the use of tried methods have simplified the design for shopping centers such as North Platte, Lamar Airways in Memphis, Tenn.; Lincoln Village in Chicago; Scottsdale Shopping Center in Chicago; Rockford Plaza Shopping Center, where construction is about to begin, and several others approaching the regional shopping center in size. The only differentiation to be made in standardized procedure, of course, is the application and effect of local codes. Designers must bear in mind that economy of original cost is the major factor in construction of the successful shopping center.

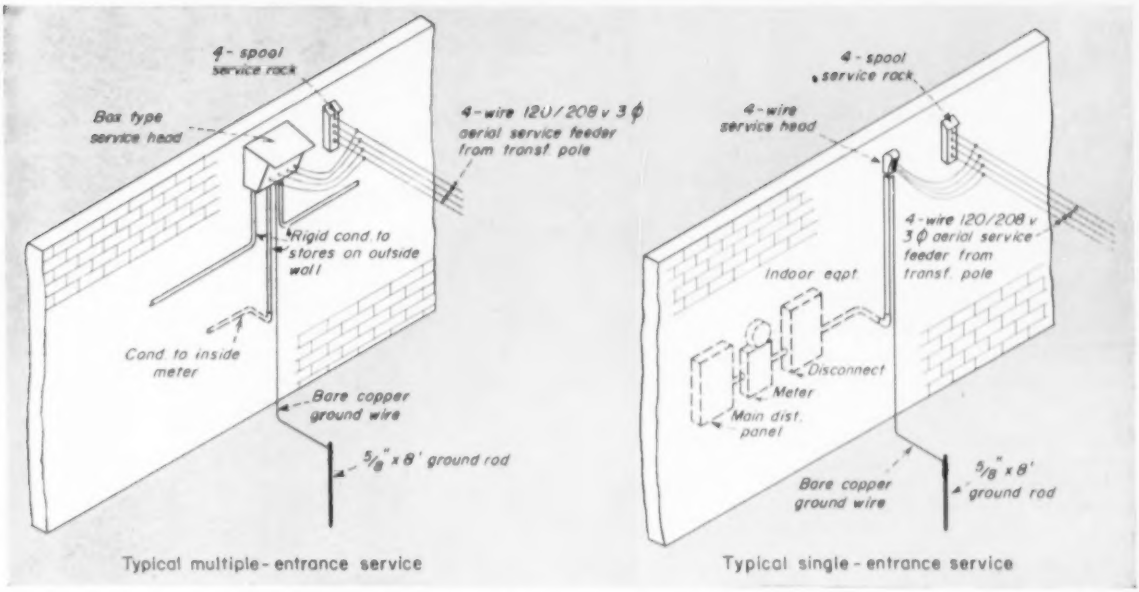
When a proposed shopping center is ready to be built, it is fundamental that the cost of the individual trades add up to the total cost of the center. Then the owner can determine whether he has sufficient funds to build the project.

Since electrical systems constitute major part of the mechanical trades, they are an important factor in the cost of construction. Particular attention should be given to what is installed and the dollar value of each item. Our experience with shopping centers has been that the overall electrical costs of the project, including the parking lighting, canopy lighting, the music systems, etc., ranges from a low of 70 cents to a high of 95 cents per square foot of floor area. When the design is such that the cost per square foot exceeds the top figure given, there is considerable danger that the budget for the center as a whole will be excessive, and that the entire project might be shelved.

Keeping Costs in Line

There are a number of things a designer can do to keep costs within budget limitations. Among them are the following guide points:

1. Use continuous rows of fluorescent lighting, wherever possible, to reduce the number of ceiling


4 - spool service rack
Box type service head
4-wire 120/208 v 3 ϕ aerial service feeder from transf pole
Rigid cond to stores on outside wall
Cond to inside meter
Bare copper ground wire
5/8" x 8' ground rod
Typical multiple - entrance service
4 - spool service rack
4-wire service head
4-wire 120/208 v 3 ϕ aerial service feeder from transf pole
Indoor eqpt
Disconnect
Meter
Main dist. panel
Bare copper ground wire
5/8" x 8' ground rod
Typical single - entrance service

MOST ECONOMICAL method of serving shopping center stores is the aerial service drop. Multiple-entrance service at left has separate service conduit to each small store fed by pole-type transformer bank. Single-entrance service at right is for a large store. If desired, underground service could be used, but it is more expensive and less flexible with respect to future expansion.

outlets to be installed. Group show-window circuits in common home runs to reduce the number of conduits going back to the panel. Wherever possible, avoid sub-feeding of show-window panels and their locations adjacent to show windows as this adds to installation cost.

2. Carry the base plugs on a continuous hot circuit to avoid conduit runs to overhead or underfloor junction boxes. Keep home runs to a minimum.

3. Locate lighting panels as close to the meter as possible. If leasing permits, run exposed conduit from the panel to the several circuits. Combined with surface mounted panels, this simplifies future extensions and rewiring in case of tenant changes.

4. Use low-tension open cables, wherever possible, for telephones, intercoms, Muzak, etc., in the attic space above the ceiling. This will reduce the amount of conduit work necessary and the initial cost proportionately.

5. Use wireways for show-window lighting with either porcelain lamp holder sockets or other fixture connecting means. Such a raceway facilitates changes in the show-window systems.

6. Time clocks and contactors should be a tenant item and should be installed by the tenant as an extra cost for his own use. This same thinking should apply to power for air conditioning requirements for the tenants. The only provision should be a space with ample copper bus in the main service for the tenants' future air conditioning loads.

7. For high-amperage services consider the use of pressure-contact service entrance switches with high capacity fuses. They are less costly than circuit breakers of the same rating and require no special enclosures.

8. Built-up switchboards are the most economical for major tenant areas where large blocks of power are used. These should be planned in advance and installed close to the service entrance to reduce the cost of heavy conduit and cable or bus duct feeders.

9. Design and locate load-center transformer banks so that service drops are as close as is feasible to each of the individual fire division groups and as close as possible to the main switches. This will result in shorter service entrance cables.

10. Consult the electric utility company early and secure pole-line and service-drop details as soon as feasible. Then the utility can locate its equipment in an easement or other space, as provided by the shopping center, for the easiest and closest access to the service brackets.

Emphasis should be placed on the fact that the overall shopping center should have competitive grade material of ample capacity interchangeable with other components. There should be some reserve capacity, usually 15% over the estimated loads. Electrical systems should be installed as simply as possible using surface mounted locations as much as possible. This, of course, may be modified somewhat by leasing directives of the tenants. This last statement is especially true of the basic lighting fixtures shown on the plans.

Detailed Fixture Data

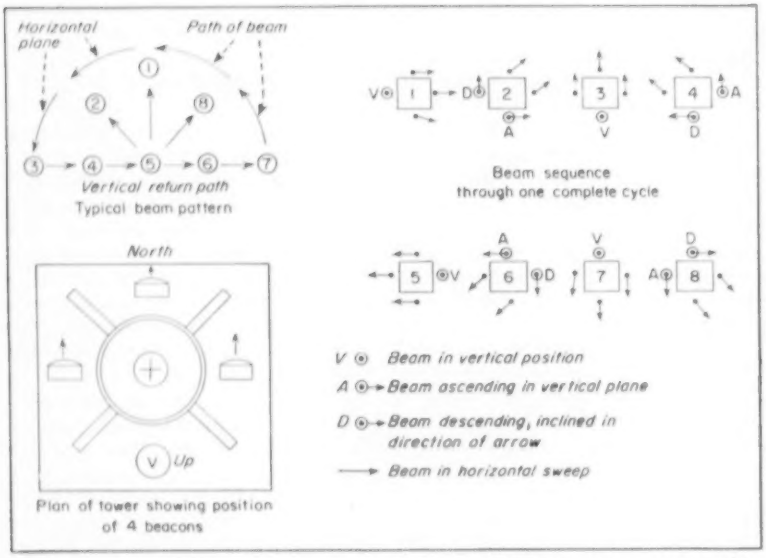
Our experience indicates that it is absolutely vital that each and every store, sales area, community area, etc., have the fixtures completely shown and detailed with specific references in the specifications. From the standpoint of the job as a whole, it is wise to show all the fixtures and require contractors to bid on all the fixtures. The only modification would be specific directives where the tenant would buy the fixtures. Such a modification should be noted on the plan and in the specifications, very briefly and clearly, to avoid confusion. Probably there is no other piece of equipment as easily confused, misunderstood, and abused, as lighting fixtures and those who are to furnish and install them.

FOUR 450-MILLION-CANDLEPOWER beacons are located at base of Empire State television tower, 1092 feet above ground level. Automatic operation of rotating lights involves use of eight motors and intricate electronic controls. Installation was made by electrical contractor L. K. Comstock & Company, Inc.

2 billion candlepower for . . .

EMPIRE STATE BEACON

Four sweep-beam mercury-vapor searchlights, installed 1092 feet above ground level atop the world's tallest office building, have sight-range of 300 miles. Automatic electronic control system, engineered by Federal Sign and Signal Corp., was installed by electrical contractor L. K. Comstock & Co., Inc.

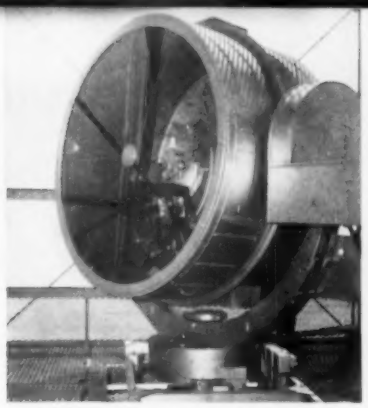

Horizontal plane
Path of beam
Vertical return path
Typical beam pattern
Beam sequence through one complete cycle
North
Up
Plan of tower showing position of 4 beacons
V Beam in vertical position
A Beam ascending in vertical plane
D Beam descending, inclined in direction of arrow
Beam in horizontal sweep

HORIZONTAL SWEEP of 180 degrees from right to left, followed by another 180-degree sweep in vertical plane (upwards then downwards) to return beam to its starting alignment is performed by each beacon in synchronous sequence.

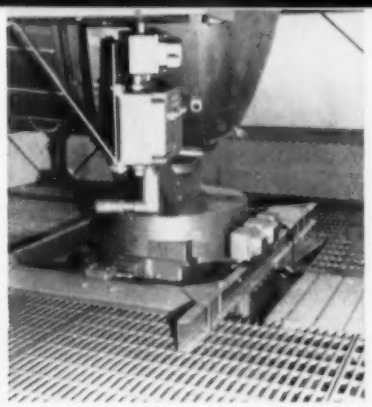
A SPECTACULAR new electronic tiara, in the form of four far-reaching night beacons, now crowns New York City's famous Empire State Building at an elevation of 1092 ft above ground level. These lights, designed to be seen from the air from as far away as Boston and Baltimore under ideal atmospheric conditions, were placed in service early last month. Combined, the four beacons generate close to 2 billion candlepower, thereby constituting the brightest continuous man-made light source in the world. Cost of the project was $1-million.

The four beacons, weighing a ton apiece, are mounted on elevated and rotating mechanisms; one light being placed on each of the building's four sides, at the immediate base of the 7-channel television tower.

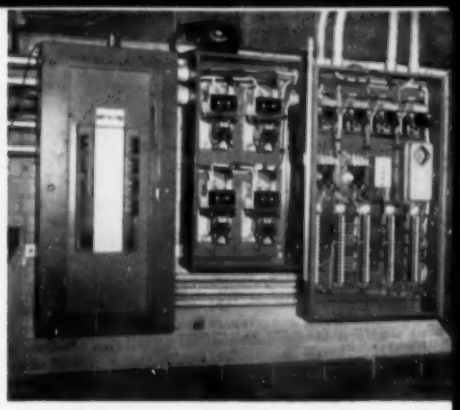
Complicated mechanisms cause the beacons to revolve in synchro-



EACH SEARCHLIGHT, together with its supporting steel framework, weighs over 2 tons. Motors incorporated in base and arbor of light rotate it 180 degrees horizontally, then 180 degrees through vertical plane. Short-arc mercury-vapor lamps have rated lives of 200 hours, arc temperatures of 1500 F and beam intensities of 450-million candlepower.



ELECTRO MECHANICAL BRAKES in bases prevent motors from coasting past true-north position when revolution of units is halted. Torque-limitation clutches between motors and gears absorb excessive wind shocks. Local switches at each beacon permit maintenance man to control individual unit without affecting other lights or the electronic controls.



CONTROL CENTER for the four beacons consists of 3-phase 4-wire main panelboard, four 100-amp safety switches, related contactors, motor starters, relays, time clocks and bank of terminal wiring strips. Power is delivered to center through two 200-amp switches, one inside tower and one adjacent to exterior control center.

nism at approximately one revolution per minute; a typical complete cycle consisting of a 180-degree sweep from right-to-left in a plane slightly above the horizontal, followed by a second 180-degree sweep in the vertical plane to reorient the beam in its initial starting position as shown in the beam-sequence diagram.

Operating mechanism includes eight 1/3-hp 3-phase totally-enclosed weatherproof synchronous motors, four for horizontal and four for vertical rotation of beacons; plus relays, time switches, cam-actuated movements, time-delays and other related electronic components. Also included are automatic controls that, regardless of the instant when the time-switch turns off the power, permit beacons to operate until the south light is pointed vertically upwards and the other three beacons are pointing north. When this point in the cycle is reached, the south beacon rotates down and *inwards*, towards the tower, so that it, also, comes to rest pointing northward. When operation begins the following evening, the south beacon first resumes its vertical position, then the four beacons again begin their sychronized cycles.

Beacons are automatically synchronized at the beginning of each cycle, thereby keeping beam patterns always geometrically symmetrical. Also, by keeping night-time sweeps always above the horizontal plane and then pointing all beacons north when not in operation, direct glare at ground level and in other tall buildings is impossible at night, and the rays of the sun cannot reflect from beacon mirrors during the day. Operation of the beacons is from sundown to midnight at the present time.

All motors incorporate electromechanical brakes to prevent beacons from coasting past their true-north position when not in use, while special torque-limitation clutches, between motors and revolving mechanisms, have been engineered into the equipment so that excessive wind forces may be absorbed before operating mechanisms are damaged. Beacons and steel supporting platforms are designed to withstand wind velocities up to 120 mph.

To fully control all of the varied movements of these units, 18 separate (two No. 4s for power; 16 No. 14s for control) wires extend from the central control panel to each of the four searchlight locations. Individual switches are also located at each beacon so that maintenance men can control beacons individually, by hand or power, independent of electronic controls or other lights on the tower.

The beacons, each measuring 5 ft in diameter and containing a 2500-watt 450-million-candlepower short-arc mercury-vapor discharge lamp, were modified from World War II Sperry Gyroscope anti-aircraft searchlights. Lamp envelopes are of quartz, rather than glass, in order to withstand unusually high internal pressures of beacons (300 psi) and high arc temperatures, 1500 degrees F, of the lamps. Searchlight modifications, and lamps, were made by Westinghouse to meet specifications for the Federal Sign and Signal Corporation of Chicago, engineers for the project. The basic idea for the beacons originated with Raymond Loewy Associates, industrial designers, while the actual installation of lights, motors and electronic controls was by electrical contractor L. K. Comstock & Company, Inc. of New York City, under the supervision of George Wrage.

Total circuit loading during normal operation is 232 amps, although, due to higher current requirements for starting motors and warm-up of mercury lamps, the load reaches an initial momentary peak of 496 amps, then remains around 352 amps for a 5-minute period.

An interesting notation concerns the distances from which these lights can be seen, for airborne travelers already have seen the beacons from 300 miles away, while ground-level observers within a radius of 80 miles likewise can see these Empire State beacons.

With these lights now in operation, the building's two observatories, on the 86th and 102nd floors, will be open every night until midnight, with guides on duty to point out points of interest.

1 **FOREST OF STEEL** columns rise up through concrete slabs as they are poured, layer upon layer, at ground level. Only edge-forms are used. Large-area slabs like these are poured in sections with a wide break between each one.

Contractor Devises

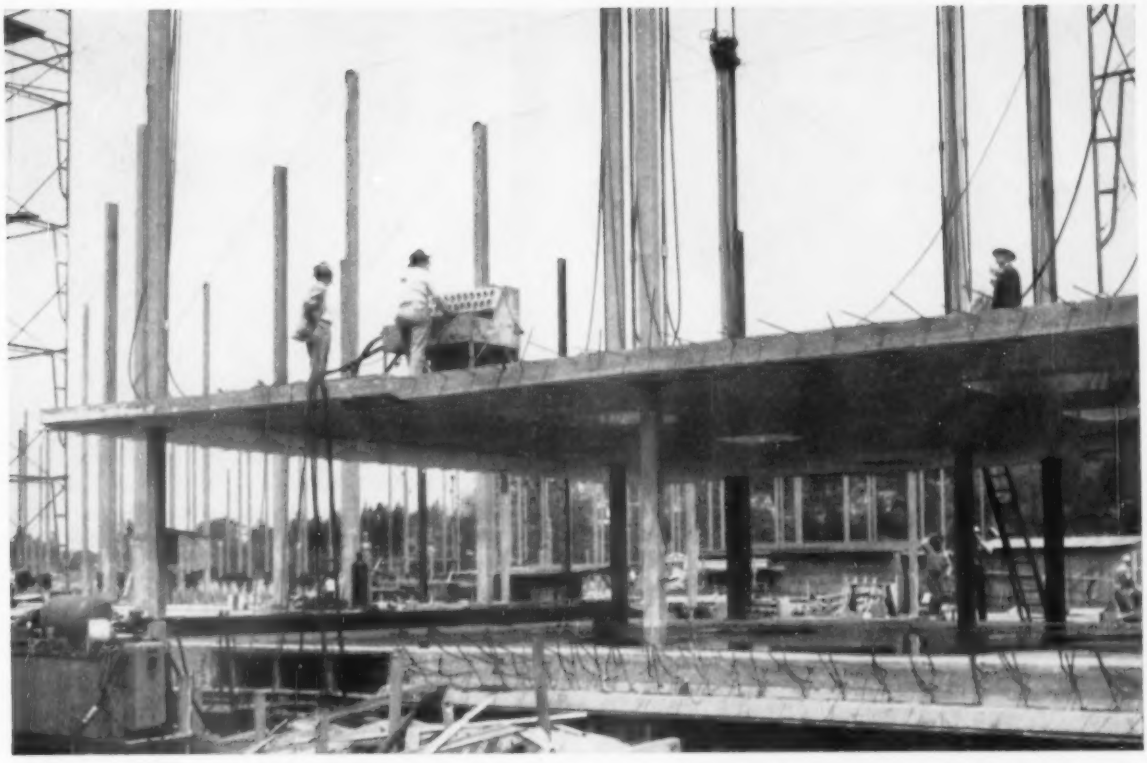
Methods For Wiring Lift-Slabs

on new Portland, Oregon, high school project. Photos show Jaggar-Sroufe Company's techniques for anchoring outlets and maintaining raceway continuity.

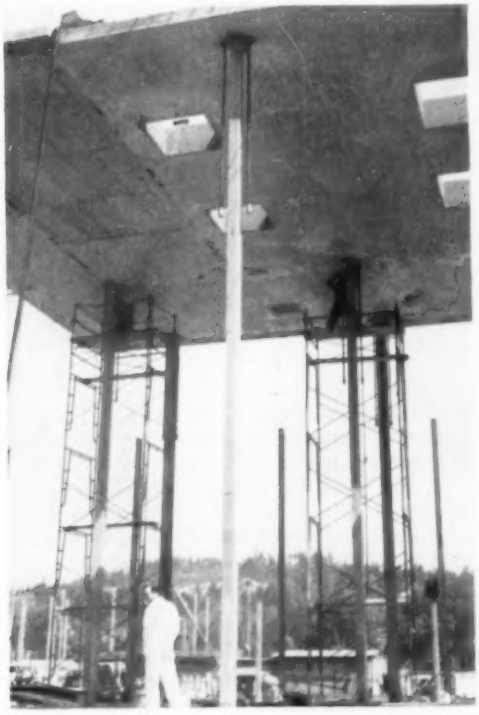
LIFT-SLAB construction made its Portland, Ore. debut in the form of the new Woodrow Wilson High School—a $3½ million, sprawling, multi-story educational facility designed to accommodate some 2,400 students. For Jaggar-Sroufe Co., Portland electrical contractor on the project, this was an initial experience with this new building technique. Starting from scratch, J-S project superintendent Charles Foster set out to solve the electrical installation problems posed by this radically different type of construction. Before the project was half completed, he and his mechanics had developed a substantial file of methods applicable to this type of work.

Like most electrical contractors, J-S previous experience with reinforced concrete was of the conventional type where the building rose floor by floor as the slabs were poured on forms supported by structures resting on the floor below. Electricians worked on these decks; nailed outlet boxes and inserts to the word forms; ran conduit between outlets; hoisted materials and tools to each deck and climbed and reclimbed ladders.

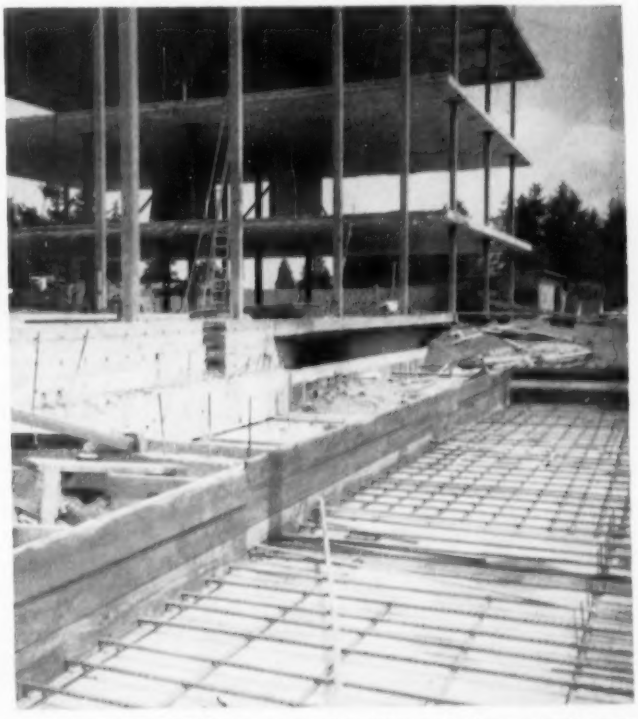
There were no elevated wood decks on this job. In lift-slab construction, (EC&M, June '54, pg. 75) concrete slabs are poured one on top of the other—pancake fashion—at ground level. In this case each slab was 10 in. thick. After the first slab was cured, it was sprayed with a liquid wax compound to prevent adhesion of the



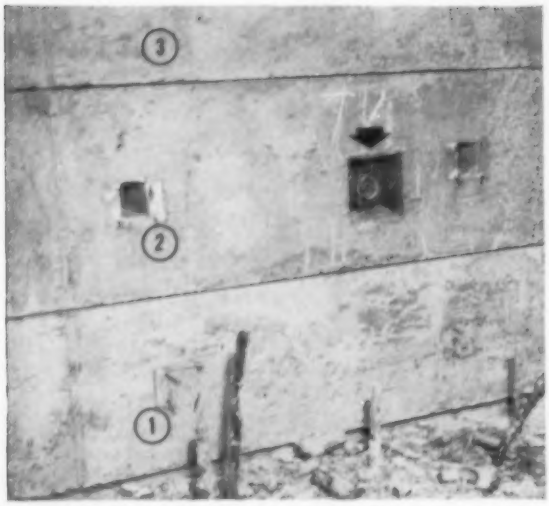
2 **GOING UP,** roof slab rises slowly into position as hydraulic jacks atop each steel column pull on slab-embedded collars on each column. Operator at console panel synchronizes operation of all jacks; controls lift and keeps slab on even keel.



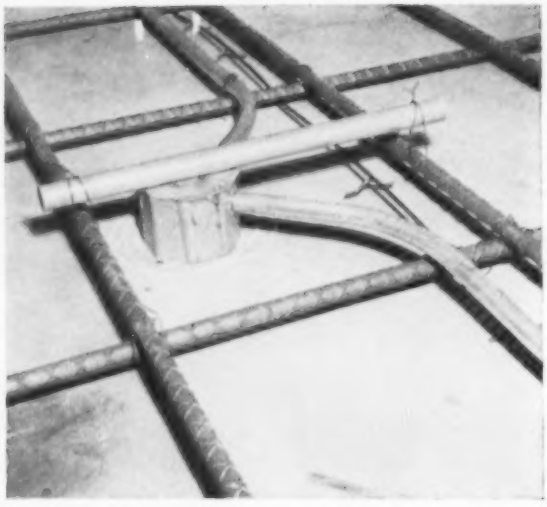
3 **IN POSITION,** roof slab is anchored by welding steel collars to supporting steel columns. Jack-rods are then lowered to ground level to engage collars of next slab and lift operation is repeated.



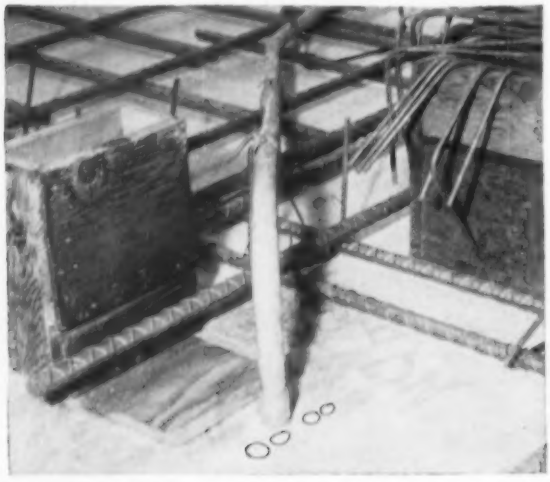
4 **ALL SLABS ARE UP** in portion of building in background with some tilt-up interior wall sections in place. Slabs in left foreground are ready to be raised; those in right foreground ready to be poured. The last slab poured is the first to be raised.



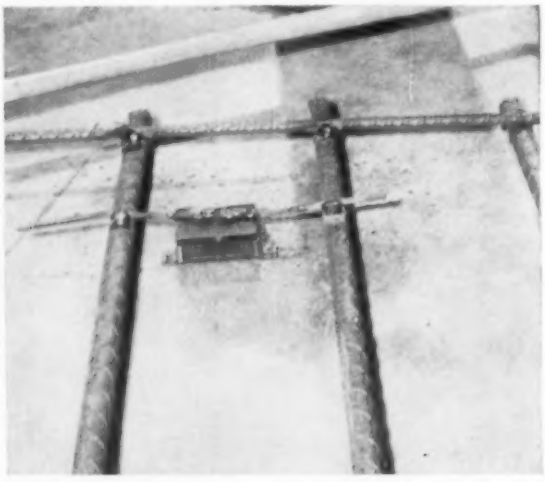
5 **THREE PANCAKE SLABS** ready to be lifted into place. Note depression (arrow) for conduit connection left by drilled, tapered 3-in. square wood block. Block method proved too time-consuming and was abandoned.



6 **BOXES ARE PRESSED** tightly against slab below by conduit bracket securely wired to heavy reinforcing steel. Wire-tie is also used on conduit runs. There are no wood forms on which to nail outlets or brackets.



7 **CONDUIT STUBS** must be accurately spotted and securely anchored to steel grid. Coupling has recessed plug filled with white patching plaster. Circles indicate patching plaster markers for conduit stub-ups in slab below.



8 **WELDED BRACKETS,** anchored to steel grid, position inserts where required, and force them tightly against slab. Top of insert was normally lower than the steel and brackets had to be bent.

next slab when it was poured. After the slabs were cured, they were lifted into place. A series of pre-positioned, heavy structural steel columns extended through steel collars embedded in each slab. Lugs in these collars engaged threaded steel rods extending down from hydraulic jacks atop each column. Operation of all jacks was synchronized through a console control as the slab was raised slowly into position. When the slab was at the desired level, the steel collars were securely welded to the supporting columns. Then the jack-rods were lowered to the next slab and the lifting operation repeated. The roof slab of the building was the last poured and the first lifted.

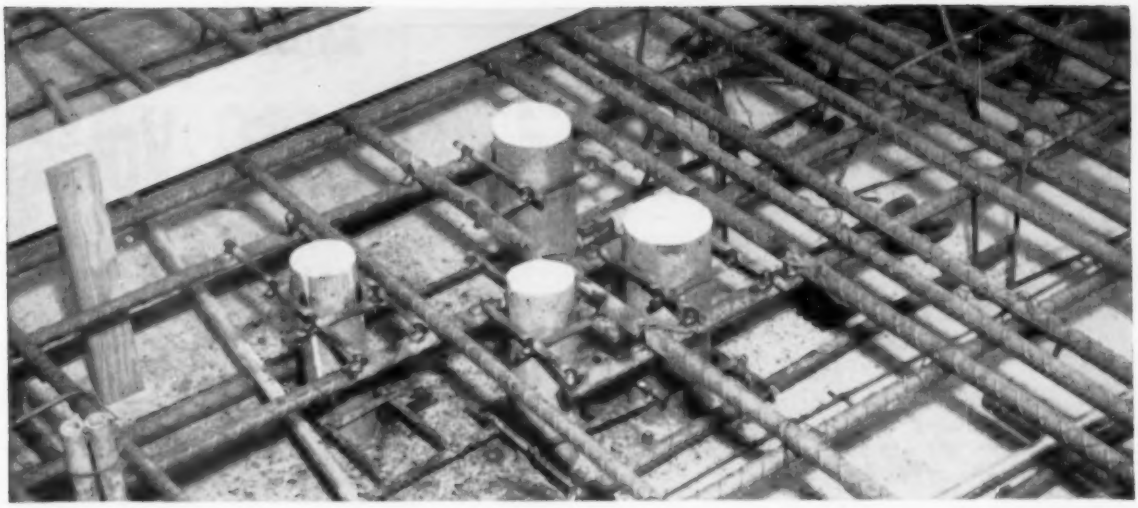
While a substantial over-all economy in construction time and lower building costs may ensue from the lift-slab technique, this may not hold true for the electrical installation. True, all "mud" work is done at ground level and this is a distinct advantage. However, this may be offset by the additional time and care required to accurately spot and anchor outlets and maintain raceway continuity between slabs.

On the Portland school, superintendent Foster and his mechanics found that:

1. Careful pre-engineering and careful layout of the conduit system is a necessity. Spotting must be "on the nose".

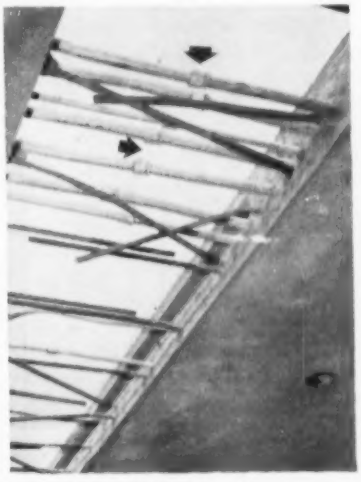
2. Outlet boxes must be securely anchored to slab reinforcing steel either by welding or wire-tie. There are no wood forms to which boxes can be nailed. The same applies to sleeves.

3. Conduit turn-downs and stub-ups must be anchored in the same manner and be flush with slab sur-



9 **DOUBLE BRACING** welded to top and bottom reinforcing steel grids support metal sleeves in the 10-in. slab. Top and bottom of sleeves are plugged with white patching to keep sand fill from seeping out.

10 **BREAK IN CONDUITS** is required where runs bridge slab sections. Erikson couplings (arrows) are backed off just before slab sections are lifted.



11 **RACEWAY CONTINUITY** is re-established after the slab sections are lifted and anchored in place. Conduit couplings are reconnected from top.

12 **FORMS ENCLOSE OPEN** strip between slab sections after conduit connections are made. Concrete pour fills void and completes continuous floor slab.

face. Protrusions that may pockmark the slab above are not permitted. In this case, the 10-in. slab thickness allowed relatively wide sweep bends on stub-ups.

4. Flush conduits terminating at slab level must be marked for easy identification. Couplings with recessed threaded plugs filled with white patching plaster proved easiest to spot and chip out when panel extensions were made.

5. Conduits passing between slab sections must be disconnected before the slabs are raised and reconnected after the sections are anchored to the supporting steel columns.

This problem of raceway continuity was a condition encountered quite frequently on the high school job. To keep slab weights within the limitations of the lifting techniques used, large-area slabs were poured in sections with a 2- to 3-ft wide "break" between them. Each section, with its protruding reinforcing steel rods and conduits, was then raised separately and anchored in place. The open strip was covered by a wood form and filled with a concrete pour in the air. Conduits bridging these "breaks" were cut, threaded and joined with Erickson couplings before the slab sections were poured on the ground. Just prior to the "lift", the couplings were backed up and again reconnected after the sections were in place.

These were some of the more pertinent problems encountered by Jaggar-Sroufe field engineers on their first lift-slab job. How they were solved is shown in the representative group of photographs taken from the methods file of Jaggar-Sroufe.

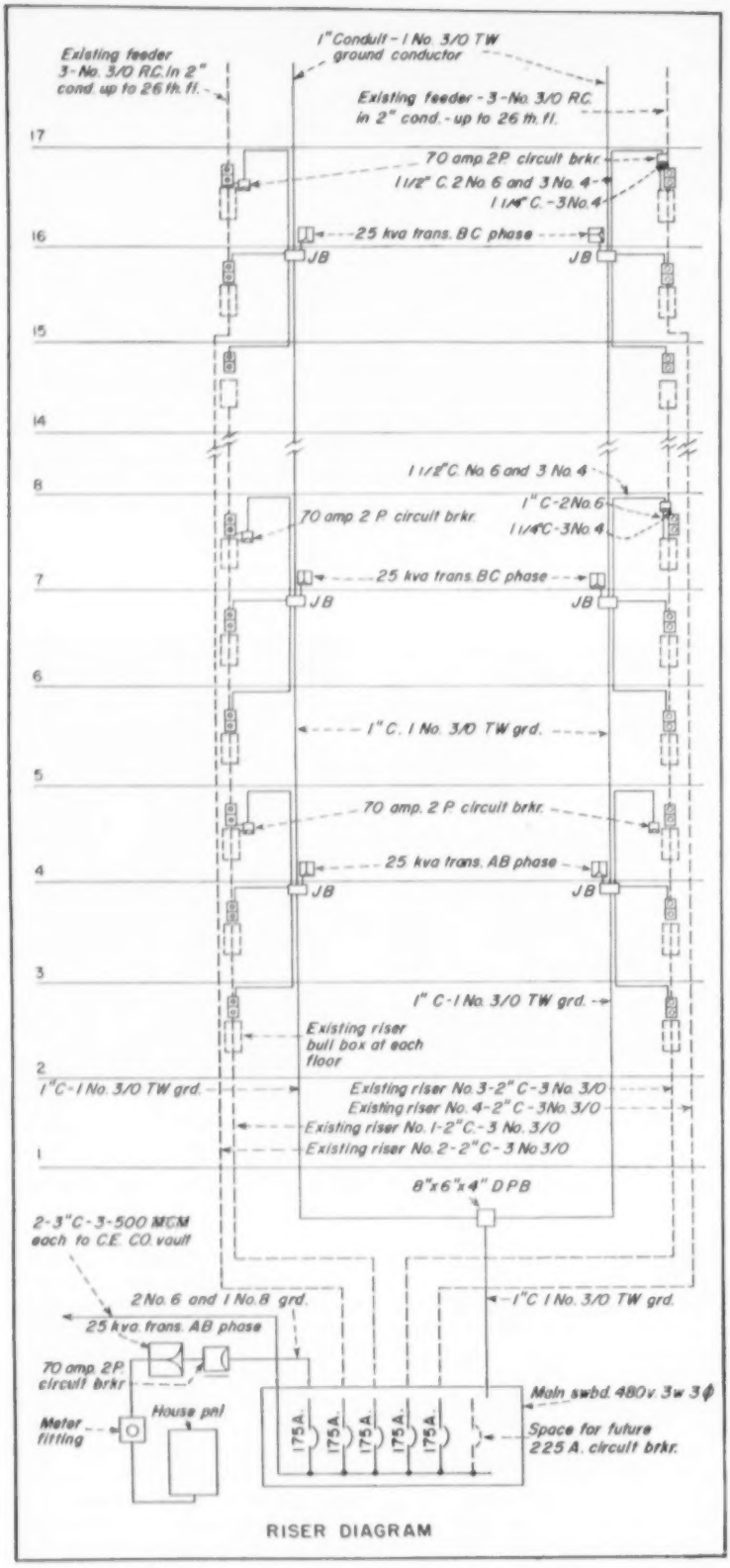

Existing feeder 3-No. 3/0 R.C. in 2" cond. up to 26 th. fl.
1" Conduit - 1 No. 3/0 TW ground conductor
Existing feeder - 3 - No. 3/0 R.C. in 2" cond. - up to 26 th. fl.
17
70 amp. 2P. circuit brkr.
1 1/2" C. 2 No. 6 and 3 No. 4
1 1/4" C. - 3 No. 4
16
25 kva trans. BC phase
JB
JB
15
14
8
1 1/2" C. No. 6 and 3 No. 4
1" C - 2 No. 6
1 1/4" C - 3 No. 4
70 amp. 2 P. circuit brkr.
7
25 kva trans. BC phase
JB
JB
6
1" C. 1 No. 3/0 TW grd.
5
70 amp. 2 P. circuit brkr.
4
25 kva trans. AB phase
JB
JB
3
1" C - 1 No. 3/0 TW grd.
Existing riser bull box at each floor
2
1" C - 1 No. 3/0 TW grd.
Existing riser No. 3 - 2" C - 3 No. 3/0
Existing riser No. 4 - 2" C - 3 No. 3/0
Existing riser No. 1 - 2" C. - 3 No. 3/0
Existing riser No. 2 - 2" C - 3 No. 3/0
1
8"x6"x4" DPB
2 - 3" C - 3 - 500 MCM each to C.E. CO. vault
2 No. 6 and 1 No. 8 grd.
1" C 1 No. 3/0 TW grd.
25 kva. trans. AB phase
70 amp. 2P. circuit brkr
Main swbd. 480v. 3w 3 ϕ
House pnl
Meter fitting
175 A.
175 A.
175 A.
175 A.
175 A.
Space for future 225 A. circuit brkr.
RISER DIAGRAM

FIG. 1—RISER DIAGRAM of 480-volt, 3-phase distribution. Existing feeders remained intact; were connected to new 3-phase panel in basement. Step-down transformers on every third floor provide 120/240-volt service to tenants.

Shift To

480 Volts,

By Russell R. McDaniels

Contract Manager and Engineer
Kelso-Burnett Electric Company
Chicago, Illinois

TENANT-OWNERS of 5000 East End Avenue, a 28-story, 100-unit apartment building just off the lake on Chicago's South Shore, bought themselves a very economical wiring package when they decided to increase the capacity of their overloaded distribution system. Through an arrangement with the Commonwealth Edison Company, they were able to shift their existing 120/240-volt, single-phase, 3-wire risers to 480-volt, 3-phase. Thus, without replacing a single conductor in any of the four risers, they were able to increase the maximum kilowatt capacity of each riser from 39.6 to 137. Total capacity of the four feeders is now a substantial 548 kw compared to the overtaxed 158.4 kw before rewiring was started.

Use of this system hinged on the installation, by the Commonwealth Edison Company, of a 480-volt, 3-phase distribution transformer in the basement vault to serve the building. The Edison Company also furnished, and will maintain, the necessary single-phase, dry-type, 480/120/240-volt transformers on various floors as well as individual tenant metering facilities.

Cost to tenants for conversion of a building of this type to 480 volts, 3-phase, was estimated—on an upset figure basis—to be about $250 per apartment. Actually, the final cost was considerably lower since careful field engineering and a number of "installation breaks" provided unanticipated economies. Even at the higher figure, the tenants considered the investment well worthwhile to attain a higher degree of electrical living. Now they will be able to install, and use efficiently, electric ranges, air conditioning units, washers and dryers and other heavy appliances.

Design and installation details were handled by the engineering

3-Phase Triples Feeder Capacity

. . . breaks riser bottleneck in 28-story Chicago apartment building. Transformers at floor levels serve tenant loads. Design provides economical upgrading of apartment house electrical systems.

electrical construction specialists of Kelso-Burnett Electric Co., project electrical contractor, who worked in collaboration with Commonwealth Edison engineers. An initial plan to install all new feeders was discarded because of cost. Since the prime goal was to secure the greatest increase in electrical capacity at least cost, conversion of the existing feeders to 480 volts, 3-phase, was the logical approach.

Several factors pointed to this solution. Two risers fed each wing of the L-shaped building constructed back in 1928. Each riser (Fig. 1) consisted of three No. 3/0 cables in 2-in. conduit. One feeder took care of the first 14 floors; the other the remaining floors. Condition of the existing feeder cables was excepfionally good. Although concealed in a wall recess, the riser conduits were only about 4 ft across a service hall from an inside stairwell with an open shaft extending the full height of the building (Fig. 2). Projection of riser pull boxes beyond the wall at each floor permitted easy installation of exposed conduit runs to transformers and apartment meters and panels. The open shaft at the stairs provided a safe, out-of-the-way place to hang the dry-type, step-down transformers and a continuous drop to the basement for the conduit-enclosed neutral ground conductor. The building had a basement transformer vault. A new 3-phase, 480-volt, circuit breaker main panel could be installed in an existing steel cabinet adjacent to the transformer vault. Conversion design took advantage of all these factors.

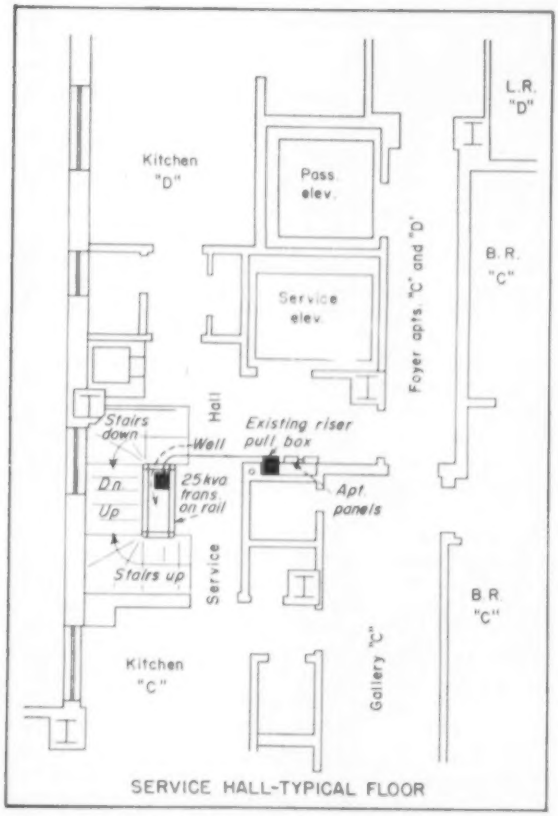


FIG. 2—PLAN OF SERVICE HALL area on typical floor showing transformer location in stairwell with respect to existing riser pull box in wall recess.

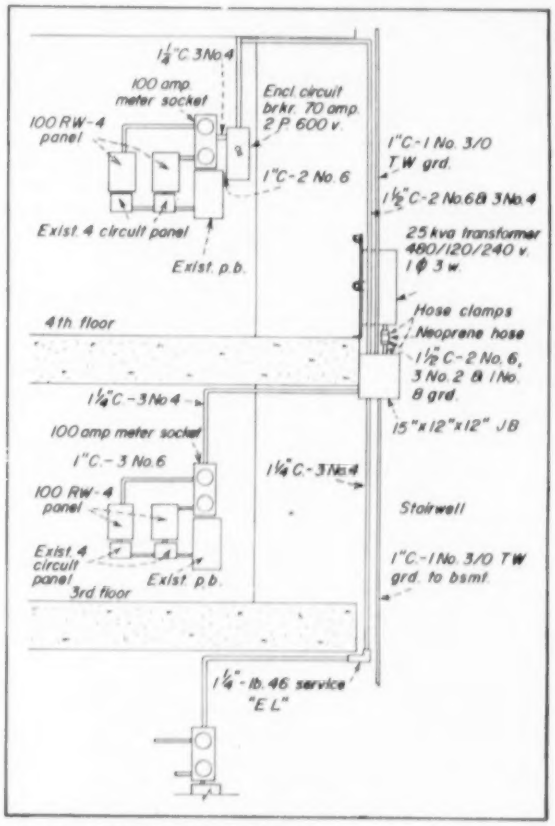
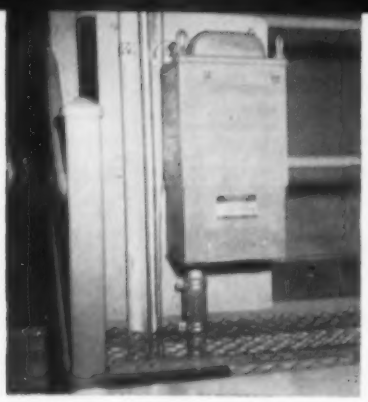
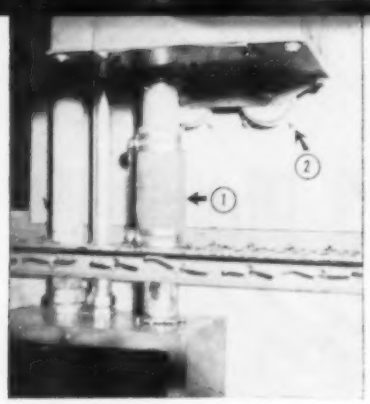

1/2"C. 3 No. 4
100 amp. meter socket
Encl. circuit brkr. 70 amp. 2 P. 600 v.
100 RW-4 panel
1"C-1 No. 3/0 T.W. grd.
1"C-2 No. 6
1½"C-2 No. 6 & 3 No. 4
Exist. 4 circuit panel
Exist. p.b.
25 kva transformer 480/120/240 v. 1 ϕ 3 w.
Hose clamps
Neoprene hose
4th floor
1½"C-2 No. 6, 3 No. 2 & 1 No. 8 grd.
1¼"C-3 No. 4
15"x12"x12" J.B.
100 amp. meter socket
1"C.-3 No. 6
1¼"C.-3 No. 4
100 RW-4 panel
Stairwell
Exist. 4 circuit panel
Exist. p.b.
1"C.-1 No. 3/0 T.W. grd. to bsmt.
3rd floor
1¼"-lb. 46 service "E.L."

FIG. 3—TYPICAL ARRANGEMENT of equipment for apartments on three floors served by a 25-kva transformer. Top floor conduits carry primary and secondary cables.



DRY-TYPE TRANSFORMERS, like this 25-kva, single-phase, 480/120/240-volt unit, are mounted in stairwells on steel-plate panels fastened to guard rails around open well. Existing drop-screen at base covers all wells.

PULL BOX UNDER transformer is terminus of all conduits from three floors; houses primary cables and secondary feeder splices. Continuous neutral ground passes through box. Transformer case and box are bonded by No. 8 wire.



NOISE CONTROL methods isolate transformer from metal conduit system. Neoprene hose (1) covers space between two short nipples connecting transformer to pull box. Vibration-eliminator pads (2) mount transformer to steel backboard.

OLD MAIN SWITCHBOARD in basement will be removed and new 480-volt, 3-phase, circuit breaker panel mounted in existing cabinet, explains Kelso-Burnett foreman Les Carlson. New panel contains 225-amp breakers.

PENTHOUSE APARTMENTS had a different arrangement. Here, a 15-kva, dry-type transformer is wall-mounted under wiring trough connecting primary circuit breaker and individual apartment service panels.

From the new 3-phase, 480-volt (secondary) unit in the basement vault to the last of 19 dry-type, single-phase, 480/120/240-volt units on the top floors, transformers provided the key to tripling the kilowatt capacity of the existing feeders. Starting at the fourth floor, and on every third floor thereafter, a 25-kva, single-phase unit was installed to step down the new distribution voltage to the 120/240-volt utilization level for tenant service. Each unit serves a total of six apartments, two per floor (Fig. 3). The exceptions are the penthouse apartments where a 15-kva unit serves two apartments. The first floor lobby, building offices and service areas are fed by a house panel in the basement.

At each 25-kva transformer location, a 70-amp, 2-pole, 600-volt circuit breaker is surface-mounted on the wall adjacent to the existing riser pull box and connected to one phase of the 480-volt feeder. An exposed, overhead run of 1½-in. EMT connects the breaker enclosure to a pull and splice box mounted to the edge of the floor slab directly under the transformer in the stairwell. This raceway carries two No. 6 conductors for the transformer primary and three No. 4 secondary conductors from the transformer back to a dual socket-meter base above the riser pull box (Fig. 3). Two 1¼-in. EMT raceways leave the bottom of the pull box and carry three No. 4 conductors, each, to socket-meter bases on the two floors below.

A No. 3/0 ground conductor in 1-in. EMT runs the full height of the building, passes through each transformer splice box and ties the neutral of the transformer secondary to a water-pipe ground connection in the basement.

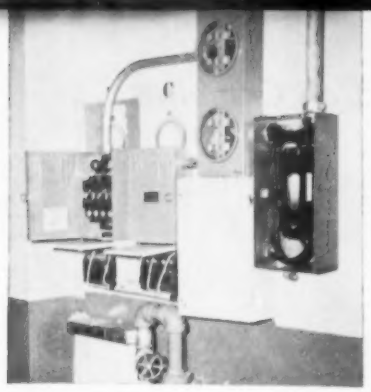
Whenever transformers are installed in a commercial or residential building, noise becomes a serious problem. This was particularly true in this project and numerous steps were taken to maintain transformer noise at a minimum level. First, the Commonwealth Edison Company supplied a standard type of transformer designed for especially quiet operation. Then Kelso-Burnett engineers took over and developed mounting methods designed to isolate any hum or noise that might accrue and prevent it from being carried throughout the conduit system.

The transformers were "hung" on the guard rail around the open stairwell shaft at each floor. This kept them away from walls which might become "sounding boards", assured ample ventilation, and provided free wall space around tenant meter-sockets for installation of larger panels in the future.

K-B's mounting design consisted of a steel-plate back-board fastened to the guard rails with U-bolts and pipe straps. Vibration-eliminator pads were inserted between the transformer housing and the back-board at the four mounting points.

Complete isolation of the transformer from the metal raceway system was accomplished by clamping a Neoprene hose coupling around the split conduit nipple between the transformer connection box and the large pull box below. All conduits enter and leave this pull box. None is attached to the transformer. Thus, any transformer hum or vibration is "damped" at the hose coupling and will not carry through the raceway system.

A careful check after the trans-



NEW APARTMENT SERVICE equipment consists of a 100-A, "main and range" panel (two 60-A, pull-outs) with four plug fuse circuits and new socket-meter base above existing riser pull box. Circuit breaker at right controls transformer.

TEMPORARY CONNECTIONS between riser pull box and existing four-circuit panels maintained tenant service while new equipment was installed. Existing circuits were connected to new panels when 480-volt changeover was made.

formers were energized revealed a barely discernible hum within a maximum 2-ft radius of the units. Beyond that, all was quiet.

Tenant Service

Increased riser capacity was not the only advantage tenants acquired through this rewiring project. A larger "service entrance" and additional circuits were included in the "package."

Before conversion took place, the average tenant electrical service consisted of a 30-amp disconnect switch and four plug fuse circuits, with submetering facilities. A few tenants had larger services and more circuits.

Now the minimum any tenant has is a nominal 100-amp panel consisting of two 60-amp, 2-pole, fused pull-outs (connected in parallel) and eight plug fuse circuits (including the four existing plug fuse circuits which were tied to the new "main-range" panel). One of the 60-amp pull-outs protects the eight 120-volt branch circuits; the other is available for a 240-volt air conditioner, range, or other appliance (Fig. 4).

Quick Changeover

Down time to tenants was held to an absolute minimum. When the project began, it was only a few minutes per apartment when jumpers were attached from the existing plug fuse cabinets to the risers. Then the old service equipment was dismantled, floor by floor, and new meter sockets, panels, transformers, circuit breakers and associated conduit and cable runs were installed. All work was completed with the exception of primary connections to existing riser pull-boxes and connection of existing plug fuse circuits to new panels at each floor.

Even while the new 480-volt, 3-phase, main circuit-breaker panel (five 225-amp breakers with 175-amp settings and space for one spare) was being installed in the basement, 120/240-volt service was maintained. The old panel had been removed from its cabinet, mounted

(*Continued on page* 146)

HOW KILOWATT CAPACITY OF EXISTING FEEDERS WAS INCREASED

Assume maximum allowable current-carrying capacity of the existing No. 3/0 RC feeders as 165 amperes

Assume power factor constant near unity value

Use basic formulae:

$$KW = \frac{I \times E \times PF}{1000} \text{ for Single Phase}$$

$$KW = \frac{I \times E \times 1.73 \times PF}{1000} \text{ for 3-phase}$$

Then: Maximum capacity per feeder under the existing single-phase, 3-wire, 120/240-volt system would be —

$$KW = \frac{165 \times 240 \times 1}{1000} = 39.6 \text{ Kilowatts}$$

Double the voltage on single-phase and the maximum capacity of the feeder would be —

$$KW = \frac{165 \times 480 \times 1}{1000} = 79.2 \text{ Kilowatts}$$

Double the voltage and shift to 3-Phase and the maximum capacity of the same feeder would be —

$$KW = \frac{165 \times 480 \times 1.73 \times 1}{1000} = 137 \text{ Kilowatts}$$

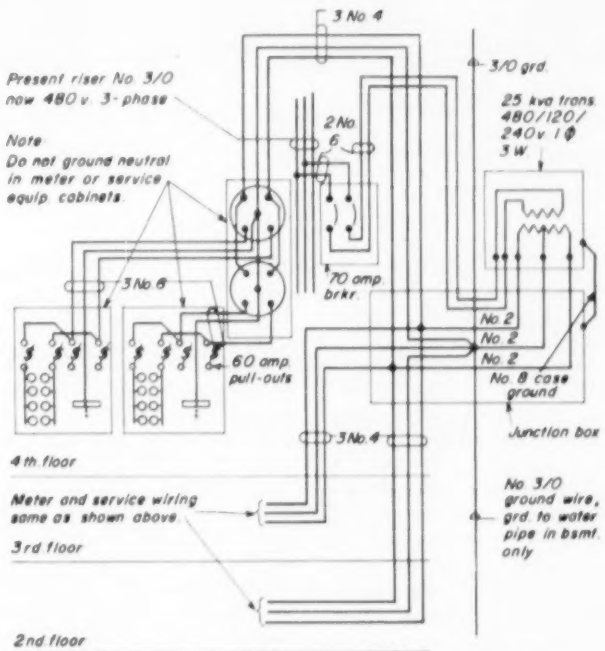
Thus: By upping the distribution voltage from 120/240, single-phase, to 480-volts, 3-phase, the capacity of the existing feeders was increased from a maximum of 39.6 KW to 137 KW

This is a multiplying factor of: 2 (double voltage) x 1.73 (3-Phase) = 3.46

A total of four feeders (each, 3-No. 3/0 RC cables in 2-in. conduit risers) serve all tenant floors in the apartment building

Total KW capacity of the four feeders under the old 120/240-volt, single-phase, 3-wire distribution was: 39.6 x 4 = 158.4 KW

Total KW capacity of the same four feeders, with voltage increased to 480-volts and system shifted to 3-phase, now is: 137 x 4 = 548 KW

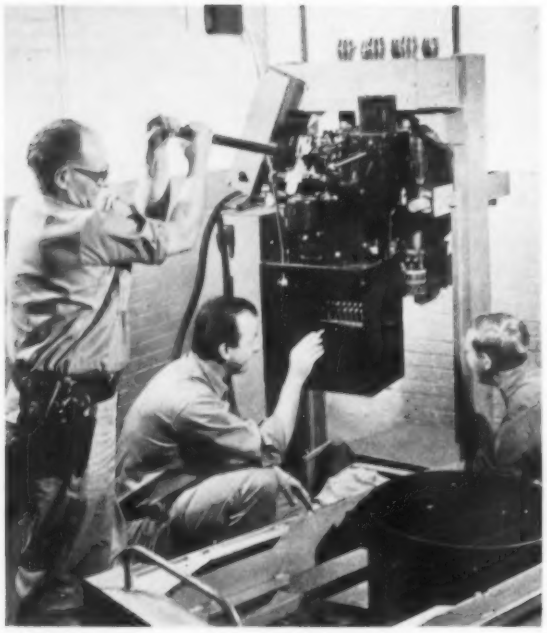

3 No. 4
3/0 grd.
Present riser No. 3/0 now 480 v. 3-phase
25 kva trans. 480/120/240 v. 1 ϕ 3 W.
2 No. 6
Note
Do not ground neutral in meter or service equip. cabinets.
3 No. 6
70 amp. brkr.
No. 2
No. 2
No. 2
No. 8 case ground
60 amp. pull-outs
Junction box
3 No. 4
4th floor
Meter and service wiring same as shown above
No. 3/0 ground wire, grd. to water pipe in bsmt. only
3rd floor
2nd floor

TYPICAL APARTMENT SERVICE WIRING DIAGRAM

FIG. 4—COMPLETE WIRING DIAGRAM of typical apartment electrical service after conversion showing transformer connections to 3-phase riser and secondary feeders to individual apartment panels. Note secondary system ground conductor (neutral) and case ground between transformer and pull box.

How Plant Electrical Department Operations Can Combine . . .

Employee TRAINING, System ANALYSIS



TRAINING: Instruction of electricians includes combination of lectures, discussions and field work under supervision of engineers from plants of equipment manufacturers. Group above is studying new electronically controlled resistance-type seam welder.

By Norman C. Vicha
Electrical Design Engineer
Plant Engineering Department
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RARELY are productive benefits of maintenance more positively demonstrated than at "Thompson Products . . . of Cleveland" (see EC&M, April, 1956), where electrical maintenance is completely self-sufficient, wide-scoped and thorough. Covering all components from entrance breakers to the rewinding of small motors, this program combines top-flight engineering and supervision with periodic cleanings and adjustments, planned shutdowns for comprehensive testing and analysis, and scheduled reconditioning and modernization of equipment. The overall program also includes practical training of personnel, keeping records and electrical plans constantly up-to-the-minute in accuracy, preparing technical reports and recommendations (including estimates) for the information and guidance of management, adopting a common-sense doctrine for standardization, and practicing experience-tailored inventory procedures.

In this connection the maintenance organization has been set up to combine dispersion of activity with centralization of command; that is, separate maintenance crews, tool cribs, spare parts and replacement materials for each of the separate plants, with a centralized engineering office at Thompson's headquarters plant in Euclid. There, incidentally, maintenance is performed by an 80-man 3-shift working force. All of these crews represent high-level efficiency, for the men are initially trained for specific assignments, then are kept constantly up-to-date through the mediums of refresher courses, printed check-lists for insuring complete inspections and servicing, plus special instruction programs whenever new or unique items of electrical equipment are installed.

For example, when a particular type of welding machine was recently placed in service, Thompson arranged for engineers from the manufacturer to spend two weeks in Cleveland, instructing both electrical and mechanical maintenance employees in recommended service and repair methods. Instruction periods were four hours each, from 8:00 a.m. until noon and from 1:00

and Equipment MAINTENANCE

. . . to insure Production Continuity

ANALYSIS: Removal and inspection of recording instrument charts by station operator not only checks condition of system but also permits bookkeeping department to allocate or proportion all charges to departments or plant divisions receiving benefits of related power, service, labor or capital expenditures involved.

MAINTENANCE: Preventive maintenance program includes thorough checking, cleaning, adjustment and replacement of worn parts on all major electrical devices during annual summer shut-down period. One of many such operations is the checking of primary breakers for contact alignment.

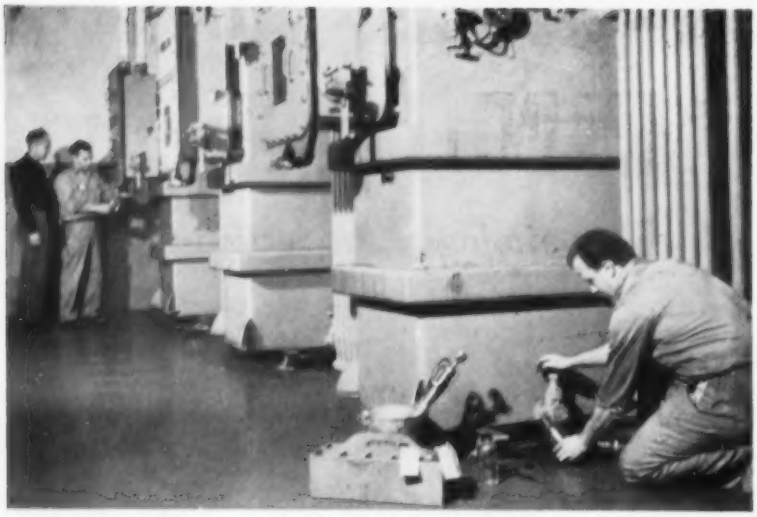
until 5:00 for a total of eight days. Selected electricians from all of Thompson's several plants attended morning sessions one week, afternoon classes the other, and instruction was divided almost equally between classroom lectures, discussion, and practical supervised field work. At the end of the 2-week period, a general discussion was held between all electrical trainees, plus all mechanical machine repairmen and pipe-fitters who had received simultaneous instruction covering their own fields of interest and responsibility. This general discussion was primarily an open question-and-answer forum to clarify overlapping responsibilities of the different trade groups.

This training procedure was found beneficial for several reasons, for it not only (1) thoroughly indoctrinates the maintenance men concerned, thereby minimizing subsequent trouble calls and shutdowns, but (2) it also trained more men in a shorter time than would have been possible by sending the men to the manufacturer's plant for this information, (3) it did not disrupt maintenance schedules too greatly, (4) it was therefore economical in both time and cost, and (5) it dove-tailed electrical maintenance with all other service routines. This illustration of a typical educational approach indicates an attention to detail which pays dividends in insured production.

Another detail, likewise linked to production, is the allocation or proportioning of all charges, for accounting purposes, to the division or plant department receiving the benefit of the related labor, service or capital expenditure.

This applies not only to maintenance man-hours and parts, but to current consumption as well. This is possible because of a complete metering plan that keeps constant check on kw consumption and demand, power factor and the like, by feeders and by substations.

This information, together with data pertaining to all substation transformers, is reviewed, analyzed and presented to management each month, thereby keeping the front office advised of load concentrations, kva or kw demand of feeders by divisions, percentage of power



SAMPLES OF LIQUID are obtained from all transformers prior to annual mid-summer 2-week plant shut-down; then samples are laboratory-analyzed for acidity and dielectric strength. During shut-down, oil or askarel is refiltered, water is removed, proper neutrality is reestablished and liquid is thereby brought back to standard values.

diversity, surplus capacity or additional power required, suggestions for improving power factor, by installing additional capacitors or synchronous motors, and margins for future electrical expansion, after the recommended amounts or reactive kva have been installed to boost pf to a 95% minimum target level.

These frequent plant surveys detect shifting or mounting power trends before they become critical, and the information has frequently provided the basis for purchasing additional transformer, control or distribution equipment. Then, as soon as equipment is installed, changes are promptly noted on all master electrical plans and drawings which are kept on file.

Scheduled Reconditioning

In addition to these monthly checks and reports, feeders and transformers receive annual attention of a far more searching nature. For example, prior to the annual mid-summer 2-week shutdown of plants (and also during January), samples of all transformer liquids are laboratory-analyzed for dielectric strength and acidity. Then, during the actual shutdown of operations, the oil or askarel is refiltered and brought back up to standard values to remove water and provide proper neutrality.

At this same time, all cables are checked for phase-to-phase and phase-to-ground resistance; and all transformer phase-to-ground resistances are noted and filed as basis for future comparisons. Any cable that is not up to standard is removed and replaced.

Planning for the annual shutdown maintenance cycle again reveals an unusual amount of attention being directed to detail, for all maintenance assignments are listed and described in detail in advance, the equipment in question is designated by location, responsibility for each assignment is specified, the scope of the work and details of the job are listed, the number of men required to complete the job is estimated, an estimated cost is submitted to management, and an exact date is fixed for each operation. Also, in the event of requiring outside contractors or additional outside labor to complete the work, the names of all individuals being considered for this auxiliary work are listed in advance so that they may be investigated and cleared for security before the work begins.

Planned annual maintenance work is divided into general and specific categories, with scheduled work further divided into categories such as primary substation, secondary substations, secondary distribution (feeders and busways) and the like.

For example, during this past summer, maintenance work on the primary substation included cleaning of outdoor-structure insulator bushings; filtering oil; aligning, checking, repairing or replacing defective parts in all primary circuit breakers; Meggering all outgoing feeders, phase-to-phase and also phase-to-ground; Meggering all transformers and disconnects phase-to-ground; cleaning, checking and recalibrating all "C.O." relays; connecting up a new oil circuit breaker cubicle (to serve a new thousand-hp air compressor), and installing a new key interlock system for two substations. Taps were also changed on a Sorgel transformer at that time to raise voltage in one department, and a voltage regulator was also installed.

All work scheduled for various secondary substations and feeders was similarly detailed, as was work listed for fans and roof ventilators, compressor rooms and forge shops, etc. This latter category listed such items as cleaning and repairing various motors, alternators and controls, shifting and reconnecting certain specified items of equipment, re-phasing of feeders between two points, and connection of new compressors and CO_2 safety controls.

In connection with this work, all system ground faults were cleared before shutdown to insure safe operation of tie breakers during the actual shutdown period. Where grounds were indicated, location and identification of the phase affected was immediately referred to the engineering department for further check and correction.

This attention to detail pays dividends, because misunderstandings or delays are practically non-existent, maintenance details are not overlooked, maximum work is accomplished in minimum time, different trade groups can more intelligently coordinate and cooperate with each other, and responsibility for subsequent performance is specifically pin-pointed.

Pre-Planned Emergency Action

The fact that Thompson has had few power outages is due not only to practical design, but also to carefully pre-planned and posted routines which are outlined in printed form for operators to follow in the event of emergencies. This practice leaves little to chance, for operators can then refer to these conveniently posted check lists and are not likely to overlook any pre-

scribed actions, or sequences of actions, if called upon to act quickly under pressure.

As an example, in the event of a complete power outage on all incoming primary lines (i.e., utility service totally disrupted due to faults outside of the Thompson plant), the in-plant operator is reminded by check list to (1) open incoming line breakers, if they have not already tripped due to undervoltage, and turn off the related alarm, (2) promptly notify the supervising engineer on duty in the plant at the time or, if the outage occurs during the 2nd or 3rd shifts, call members of the engineering staff, in a listed sequence, at their respective homes (phone numbers are listed) until someone in authority is contacted and informed. This engineer, in turn, notifies the utility company's trouble board.

The operator on duty is further reminded by the checklist to (3) trip all outgoing power feeder breakers, but leave lighting breakers closed, (4) open all 4.8-kv tie breakers, (5) reset targets on under-voltage and reverse current relays, and stand by.

When indicating lamps on incoming line breaker doors illuminate, indicating restoration of power by the utility company, the operator is then reminded to (6) contact the utility trouble board to advise them that the plant load is about to be replaced on the lines. Then, provided all utility faults have been corrected and permission to restore the plant load is granted, the operator (7) closes incoming line breakers, one at a time, and (8) closes all outgoing feeder breakers.

During this last operation, if a 4.8-kv power feeder breaker trips upon being reset, indicating inductive starting overload, the operator is reminded by check list to (a) dispatch men to the substation involved, to reduce the load on that station by tripping all secondary 480-volt power feeder breakers. Then, after (b) resetting the related 4.8-kv breaker, he (c) directs that the tripped 480-volt secondary feeder breakers at the substation be reclosed, one at a time, permitting sufficient time to elapse between successive closings to allow large inductive loads to pick up fully without overlapping.

Similar check lists concerning all other possible emergencies have also been carefully prepared in recommended step-by-step sequences and have been conveniently posted for reference. In addition to full-paragraph recommendations, such as those just cited, these sequences are also restated in cryptic one-or-two-word directives, so that an experienced operator can refresh his memory by a quick reference to the check list.

MOTOR REPAIR at Thompson covers everything except rewinding of major rotating devices. Separate maintenance crews with their own stocks of materials and inventory parts are located in all of the company's several plants, although all engineering is centered in the Euclid headquarters where the electrical maintenance involves an 80-man 3-shift organization.

PLANT ENGINEERS conduct frequent surveys to detect mounting power trends or shifting load concentrations before they become critical. Data is then analyzed to determine extent of needed additional transformers, capacitors or other equipment. As soon as equipment additions or changes are completed, all master electrical plans and drawings are corrected, thereby maintaining accuracy.

Standardization Pays Premiums

Wherever possible or feasible, inventories of spare parts, replacement motors, cables in stock and the like have been minimized through the practice of standardization. For example, (1) underground 4.8-kv feeders are limited to three sizes (500MCM, 4/0 and No. 2) and, where additional capacity is required, these basic sizes are paralleled. Morover, (2) distance between manholes is limited to 300 ft so that cables may be ordered and stocked on standard 300-ft reels. (3) All capacitors have capacities of 15 kva, multiple units being installed together when power-factor requirements so dictate. (4) Flamenol dropcords for connecting production machines with plug-in busway are stocked in standard 30-ft lengths, since this is the maximum possible distance from any machine to truss level (vertically), then (laterally) to the nearest duct run. (5) Lighting fixtures are of standard construction and dimensions to reduce inventory variety, permit plant-wide interchangeability, simplify cleaning routines and minimize stock of ballasts, lamps, glassware, louvers and the like. (6) Circuit breakers are likewise standardized to permit interchanges and reduce inventory.

This practice has resulted in numerous advantages, because capital funds for inventories have been released for investment in other channels, storage space has been released for production purposes, maintenance procedures have been simplified, and the possibilities for obsolescence, deterioration, breakage and pilferage have been greatly lessened.

These plus values are especially apparent when considering such costly and perishable items as radio and industrial electronic tubes related to the operation of rectifiers, voltage regulators, ignitrons, thyratrons, cold-cathode installations, photo-cell devices, converters, relays, communication systems and dozens of other modern industrial aids.

With electronic applications constantly multiplying and expanding, tube inventory can become both extensive and costly, as indicated by the fact that Thompson uses over 300 different tube types—the average cost per tube being between $6 and $7, with some tubes valued as high at $600. Since actual annual tube replacement approximates 3000 units, this yearly

STANDARDIZATION OF TUBES, checking their condition with modern instruments and using cross-indexed sheets for reference purposes has resulted in reduction of inventory by hundreds of tubes representing thousands of dollars.

MEGGERING of underground feeder cables is also included on the summer shut-down maintenance schedule. Prior to shut-down, all system ground faults are cleared to insure safe operation of tie breakers.

maintenance item runs around $20,000, without including the value of extra, unused tubes carried in stock. It becomes apparent, therefore, that all possible methods for minimizing tube inventory are given serious consideration.

One major step in this direction was the compilation of a cross-indexed reference sheet to eliminate duplication and to weed out those tubes which have become superseded or obsolete.

It is evident that, without such a reference, duplication could become extensive, for many tubes with identical or similar characteristics (but made by different manufacturers) are identified by varying numbers, prefixes and suffixes.

Condensed Tube Inventory

It would be quite possible, therefore, for maintenance men to unwittingly requisition the purchase of additional new tubes, although acceptable substitutes might already be available in stock. There are also cases where original tubes have been superseded by units of superior design, so that exact letter-number duplication of a tube could conceivably result in less-than-otherwise-possible efficiency.

These possibilities are lessened through the compilation of a 5-column check-list, the first column listing all tubes in terms of common nomenclature (disregarding any prefix or suffix letters) with tube designations listed numerically in ascending sequence, such as OB3, 1C, 2A3, 3C23, and so on.

Certain tubes on the list are also marked with a single or double asterisk, denoting that a tube is expensive, or *very* expensive. The exact cost is not mentioned on the list, yet the asterisks serve the purpose of warning maintenance men to use discretion in ordering, handling, installing and operating the tube.

Second and third columns in the tube check-list record substitute tubes (where applicable) and their comparative ratings; i.e., "I" for identical; "E" for excellent, or "G" for good. Substitute tubes are listed only when they are interchangeable without circuit modifications, being either identical (although with different nomenclature) or having somewhat similar characteristics.

The letters E and G indicate that tubes are not identical, yet can be used as acceptable substitutes in emergencies, until identical (I) tubes are again available from stock. As a normal procedure, however, E and G tubes are never used in calibration or measuring apparatus, and metal and glass tubes are not interchanged when either type is definitely indicated in the first column.

Still another column in the check-list gives a brief description of the tube and its application, thus serving not only to identify the tube, but to differentiate between unlike types having the same or similar numbers. This prevents misunderstandings in both ordering and usage.

As illustrations to the above, we can note from the check-list that tube OA3 (used in a voltage regulator circuit) has an identical substitute in tube VR-75; tube 6E5 (used in a tuning indicator circuit) has excellent substitutes in tubes 6U5 and 6G5; and that tube 6BA6 (for a remote cutoff pentode) has a good substitute in tube 6AU6 in an emergency.

The remaining column in the check-list indicates the minimum quantity of tubes to be carried in the supply stores of each of Thompson's several plants. And, when tubes are indicated as being either superseded or inactive (i.e., not used with regularity), their replacements are obtained by interplant transfers of inventory, rather than by additional purchase from outside vendors.

Changes in this check-list are made promptly, either as new equipment is installed, equipment is re-activated after a period of inactivity, or better tubes become available; and the list is completely reviewed and brought up to date every six months.

Due to certain conditions governing warranty of tubes (such as high-priced tubes having warranties for only a certain number of hours, days or months), it is Thompson's practice to order tubes from a vendor as items become low in inventory, but to request actual shipment to the plant only when the need becomes imminent. Since warranties begin at the time a tube leaves a vendor's premises, this practice eliminates the possibility of using a new tube which is already out of the warranty period. Expensive tubes handled in this manner are designated on the list by the letter V (indicating that it should remain in the vendor's inventory until required).

These several examples of practical engineering, conscientious supervision, precise installation, thorough maintenance, planned modernization, personnel training, intelligent operation, and common-sense inventory practices forcefully emphasize two basic facts: that modern industry is supported by an electrical framework and, at Thompson Products, the electrical system has received justified priority from the design stage onward.

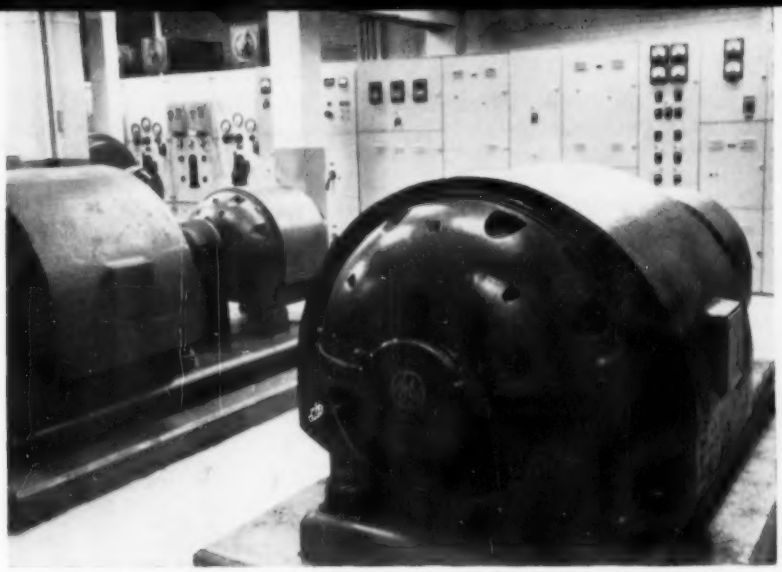


FIG. 1—POWER SOURCE of high frequency current is these two 150-kw, parallel direct connected, 420-cycle, 3-phase generators in the building basement.

Industrial Use of High-Cycle Power

. . . . . Pertinent facts on application, installation, operation and maintenance of 300 to 2000-cycle systems; also derating data for high-cycle use of 60-cycle control equipment.

By Vernon C. Geckler, *Plant Engineer*
New Departure Division, General Motors Corporation, Bristol, Conn.

THE use of electric power with frequencies higher than 60 cycles in industry is not new. It was used satisfactorily to a limited degree over 50 years ago. Little was known at that time as to its possibilities or its problems. New Departure Division of General Motors Corporation developed the first application of 300-cycle electric power in industry in 1904 and is considered the pioneer in this field. Today, high-frequency power is a recognized power source for internal grinding, portable tools for high production assembly lines, woodworking tools, and industrial and commercial lighting.

This latter use of high-frequency power is a recent development which shows considerable promise for new, large lighting installations. Advantages over the standard 60-cycle equipment are higher lumen output, longer lamp life (approx. 12%), reduced cost of replacement ballasts, less heat loss, unity power factor operation, no stroboscopic effect, no radio interference, approximately 20% less weight per fixture and a 10% reduction in power losses. Disadvantages to this system could be the unavailability of 3-phase power, such as in outlying districts, and the present higher initial cost of installation due to converter requirements. High-frequency lighting can be successfully operated from a frequency of 360 cps up to 10,000 cps at which point the increase in lumen output levels off with an over-all increase of 13%.

The General Electric Co. is now in the development stages of producing a magnetic converter for 360 cps which, if successful, will reduce the present high initial installation cost. However, it will be a constant current device and applicable to only such installations where flexibility of turning on and off of individual fixtures is not required, such as in large gymnasiums or auditoriums. Rotary converters are now available in packaged units which can be supplied in the frequency desired and will satisfactorily supply varying lighting load conditions.

High-frequency power, supply, and motors provide the means of obtaining the desired speeds in surface feet per minute, rpm advantages present in the use of polyphase motors, and reduced physical

size compared to standard 60-cycle equipment. It is an accepted fact that grinding wheels will produce the maximum cut and quality finish with proper wheel breakaway at a specific surface speed. Surface speeds for vitrified grinding wheels usually range from 6,000 to 7,000 ft per minute, and rubber base grinding wheels from 8,000 to 10,000 ft per minute.

As an example: to obtain maximum grinding wheel output with minimum wear to grind an internal bore of .6693 in., a spindle speed of 43,200 rpm is required, with a wheel diameter of .602 in. (90% of hole diameter), producing a surface speed of 6800 ft per minute. These speeds would be highly impractical and expensive with standard 60-cycle motors and drives.

Although high-frequency is often used to obtain 9000 rpm and below, it may also be economically obtained with standard 60-cycle equipment. Portable tools, as generally referred to, are single-phase, commutator-type motors and are not designed for continuous heavy-duty applications usually required for high production lines. High-frequency portable tools are available, are smaller per horsepower rating with less weight and are of polyphase squirrel-cage construction requiring minimum attention.

TABLE I — HIGH-FREQUENCY INDUSTRIAL MOTORS, GENERATORS AND FREQUENCY CONVERTERS

RATING STANDARDS

MG1-7.556 Voltage and Frequency Ratings of Motors.

A. General

The Standard full-load voltages and frequencies shall be:

	Frequencies, Cycles											
Band	60	120	180	240	360	540	720	1080	1440	2160	2880	4320
	Volts											
1	220	440										
2		220	330	440								
3		147	220	293	440							
4			110	147	220	330	440					
5					110	165	220	330				
6								165	220	330		
7									110	165	220	
8										110	147	220

At frequencies other than those listed above, the voltage will be in direct proportion to the frequency.

Note: For portable hand tools, the preferred voltage is 220 volts (250 volts maximum) regardless of frequency.

B. Internal Grinder Application

For internal grinder applications, the voltages and frequencies shall be:

	Frequencies, Cycles								
Band	120	180	240	360	540	720	1000	1440	2000
	Volts								
2	220	330	440						
4			147	220	330				
5					165	220	306		
6							153	220	306

Recommended Standard 5-15-1941, revised 8-7-52, NEMA Standard 11-12-53.

MG1-7.557 Generator and Frequency Converter Rating.

The high-frequency generator and frequency converter rating shall be expressed in kilowatts available at the terminals at 0.8 power factor. Recommended Standards 9-11-1929, revised 8-7-52, NEMA Standard 11-12-53.

Motors

Generally, a high-frequency motor is approximately four times smaller and four times less in weight than a standard 60-cycle motor. This will vary somewhat, depending upon the size of the motor being considered. The 3-phase motor has been generally adopted for high-frequency use basically because it is the simplest and most trouble-free type and is readily understood by the average industrial electrician. High-frequency motors can be wound for any phase, governed only by physical limitation in motor design, and are now readily available for machine tool applications from the majority of larger electric motor manufacturers. They may be obtained as a complete motor ready for installation, or as separate stators and rotors ready for assembly in any special enclosure required for a given application.

Manufacturers of internal grinding machine tools have performed an outstanding service in the development of the use of the high-frequency spindle-motor and have been instrumental in establishing a standard for high-frequency industrial motors, generators and frequency converters. This standard, approved by NEMA, August 7, 1952, is reproduced in Table I.

Portable high-frequency hand tools are also readily available from tool manufacturers and are usually of a standard design for operation on either 180-cycle or 360-cycle systems. Grounding of all non-current carrying metallic parts of the motor is necessary for personnel safety and should be accomplished by the usual methods acceptable to the National Electrical Code.

DERATING OF CONTROLS

Standard 60-cycle control devices, such as relays, line starters, disconnect switches and pushbuttons, can be used for the control of high-frequency motors. However, in application it is necessary to apply a derating factor to prevent excessive heating. *All devices which open or close all phases of the high-frequency circuit, including fuses in disconnect switches, should be derated in accordance with the listing in Table II.* The ratings in Table II apply only to units mounted in the open. *These units should be derated an additional 15% when they are installed in an enclosure,* such as a steel case or control center. Generally speaking, the interrupting capacity of circuit breakers and disconnect switches is not affected by the higher frequencies except in certain instances. Before application is made, the manufacturers' recommendations should be obtained.

LUBRICATION

Motor-bearing lubrication is most important where high speeds are involved, due to the increased friction and heat created within the bearing. Shaft speeds up to 6000 rpm can be satisfactorily lubricated with a paraffin oil with a

TABLE II — DE-RATING OF CIRCUIT BREAKERS — CURRENT CARRYING CAPACITY AT VARIOUS FREQUENCIES (AT 25°C. AMBIENT — BREAKERS IN OPEN)

Breaker Frame	Normal 60 Cycle and DC Rating	90	120	180	240	300	400	500	600	700	800
50A	15	15	15	15	15	14	14	13	13	12	11
	20	20	20	20	19	19	18	17	16	16	15
	30	30	30	30	29	29	28	26	24	23	22
	40	40	40	39	39	38	35	34	32	30	29
	50	50	50	49	48	47	44	42	39	36	34
100A	15	15	15	15	15	14	14	13	12	12	11
	20	20	20	20	19	19	18	17	17	16	14
	30	30	30	29	29	28	26	25	24	23	22
	40	40	40	39	38	37	34	33	31	29	26
	50	50	49	48	47	45	42	39	36	33	30
	70	70	69	67	65	63	58	53	49	45	41
	100	99	98	95	92	88	82	74	67	61	56
225A	70	69	69	68	67	66	65	64	62	61	59
	100	99	99	97	96	94	92	90	88	85	83
	125	124	123	121	119	117	114	112	109	106	103
	150	149	147	144	142	139	135	131	126	122	118
	175	173	171	168	164	160	155	149	143	138	132
	200	198	195	190	185	181	172	165	157	149	141
	225	222	218	212	206	200	190	180	170	160	150
600A	125	124	123	122	120	119	117	115	113	112	110
	150	149	148	147	145	143	142	139	136	134	132
	175	173	173	171	169	167	165	163	160	157	155
	200	198	198	196	194	192	189	185	182	179	175
	225	223	222	218	215	212	207	201	196	191	185
	250	247	245	241	236	232	224	217	209	201	194
	275	271	269	264	257	252	242	234	225	216	206
	300	297	294	288	282	275	263	254	243	232	221
	350	345	342	333	325	317	302	288	275	261	247
	400	393	389	378	368	357	340	322	305	287	270
	500	488	483	467	450	434	406	378	350	323	295
	600	585	578	555	533	510	473	437	400	362	323

100-second rating using drip oilers or a grease lubricant such as Andox C.

For speeds higher than 6000 rpm a mist lubrication system, using a DTE medium oil with a 240-second rating is required if good bearing life is to be obtained. Actual operating experience at the New Departure plants in Bristol has shown that bearing life has been increased over 400% by the use of mist lubrication systems. As a result, this system completely replaced all other methods.

The oil mist system delivers to the bearing the correct amount of oil in a mist form which reduces the fluid friction and produces a positive pressure within the bearing, preventing the entrance of foreign material. Compressed air must be thoroughly filtered before the oil is introduced and a pressure regulator provided to obtain the correct quantity of mist. The installation of a pressure switch, which will prevent the starting of the high-frequency motor unless the mist lubrication system is in operation, will prevent the burning out of the motor bearings. This can occur within a matter of seconds without the proper lubrication. Failure of a motor bearing usually causes the motor to slow down, resulting in an excessive current to be drawn by the stator winding and in turn builds up sufficient heat in the rotor to melt the end connection of the squirrel-cage winding. This happens very rapidly and considerable damage occurs all because of a bearing failure. For these reasons, careful consideration and attention should be given to this subject.

COOLING OF SPINDLE MOTORS

Dependent upon the application and speed involved, the method of adequate cooling of the spindle motor will fall into three classes: open-type motors for atmospheres which are free of air-borne contamination; totally enclosed motors for contaminated atmospheres; and liquid-cooled motors for speeds over 24000 rpm. As frequency is increased to obtain these higher speeds, the motor losses automatically increase, converting a greater amount of power into heat. This amount of heat cannot be dissipated by air cooling due to the physical inability to pass sufficient air through the motor. Consequently, liquid cooling is the only practical method of controlling the motor heat rise.

Practice has shown that satisfactory liquid cooling may be obtained by passing a quantity of compound or oil, normally supplied to the machine for cooling the work, through the motor providing the liquid has been filtered to remove the majority of abrasive and steel. Water soluble compounds are most satisfactory, due to the rapid heat transfer. Oils tend to have a slower heat transfer dependent upon their viscosity. In many applications it has been found necessary to use oil as a cooling medium for the grinding process to obtain the maximum finish and machine output, as in the case of form grinding with vitrified wheels. The large amount of heat generated may cause a build-up in oil temperature and require the addition of refrigeration equipment to automatically hold a safe operating temperature of the coolant. The liquid cooling ducts in the motors are designed in such a way that there is a minimum of build-up and they wash clean very effectively with the usual pressure present for the cooling system.

MAINTENANCE REQUIREMENTS

The maintenance of high-frequency controls, motors, generators and converters is not much different than that experienced with 60-cycle equipment. It is important, however, to note a few items which could cause considerable concern. When dismantling and overhauling a high-frequency motor, the rotor should be both statically and dynamically balanced before assembly. If this is not done, vibrations due to the high speeds involved often will cause chatter in the work and result in the failure of the spindle bearings. Special care should be given to spindle bearings during assembly insofar as their cleanliness and their con-

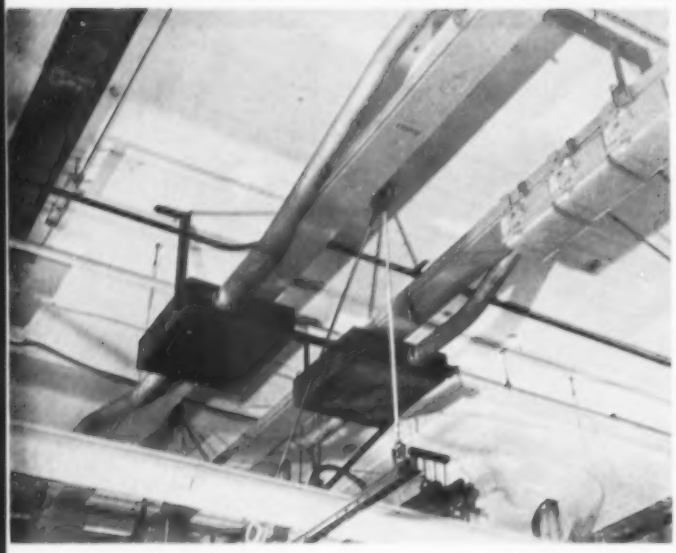


FIG. 2—CABLE FEEDERS connect to midpoint of 60-ft. standard bus duct runs at pull box junction. Maximum of 30 feet of duct on either side of power tap is dictated by high reactance loss on high frequency circuits.

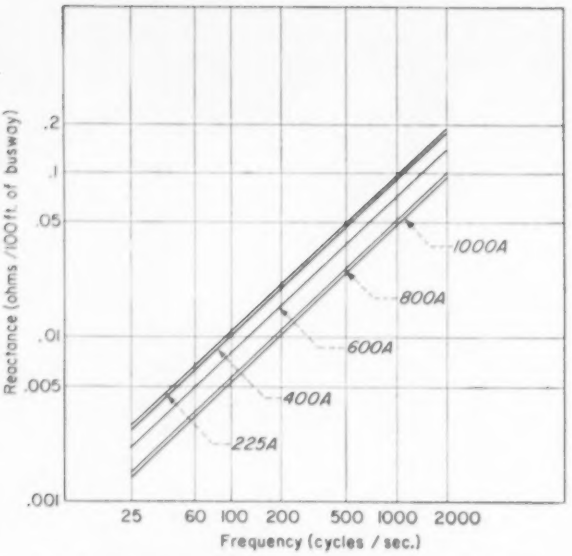


FIG. 3—REACTANCE CURVES of standard bus duct sizes from 25 cycle to 2000 cycle per second operation. Note sharp increase in reactance above 60 cycles and that rate of increase is independent of busway rating.

dition is concerned if we are to expect satisfactory bearing life.

In regard to electrical controls, a loose contact or worn contact in a motor starter, disconnect switch or relay will cause very rapid heating and eventually a failure to the piece of equipment. It is recommended that an adequate preventive maintenance program be established to minimize production loss due to this type of failure.

High-Frequency Power Sources

MOTOR GENERATORS

The motor-generator set is the most common source of high-frequency power and can be obtained on special order from the larger equipment manufacturers. These are not stock items and are made to order in standard generator sizes for the voltage and frequencies specified. V-belt connected motor-generators are the most commonly used due to their flexibility in changing speeds for different frequency requirements. If parallel operation of generators is required to obtain flexibility in capacity, a direct coupled motor and generator are required and may be paralleled the same as 60-cycle equipment.

CONVERTERS

Frequency converters are available to change 60 cycles to a higher frequency. They have the advantage of being self-contained with appearance of a single-motor or generator, take up considerably less floor area, and are quite maintenance-free. Converters are desirable for any fixed load application such as furnaces, etc. Voltage regulation on converter sets is approximately 15% and is obtained by series capacitors in the converter winding circuit. In this equipment the motor and converter windings are located in one frame on the same stator laminations, the rotor consisting of cog laminations with a squirrel-cage winding.

If a converter is to be applied to a varying load condition, it is advisable to consult the manufacturer as to application, particularly in the larger sizes, as it is possible to experience a self-excitation which will cause motors to slow down and both voltage and frequency will become unstable. The converter also has the disadvantage of not being able to change speeds or frequencies and cannot be used where flexibility in frequencies is required.

VOLTAGES

Direct generator voltage may be used in distribution or it may be transformed in the same manner as 60-cycle power. However, the transformation requires special high-frequency transformers, usually dry-type auto-transformers, which can be obtained from most transformer manufacturers. More importantly, their use adds a substantial amount of reactance and resultant voltage loss and should be avoided wherever possible. Corrective capacitance can be applied in the form of high-frequency capacitors in such cases.

The value of voltage generated, distributed and used by the motor is not of importance insofar as performance is concerned as long as this value falls within the practical application and safe operating conditions. Referring to Table I, the voltage of the generator will be in direct proportion to the frequency which is controlled by the speed of the generator.

As an example: a motor operating on 120 cycles at 147 volts can also be used on 360 cycles at 440 volts and perform with the same efficiency (an increase of 300% in frequency and 300% in voltage).

Frequently, standard 60-cycle measuring instruments can be used to obtain values of voltage, current, kilowatts and power factor. For accurate readings, however, a factor must be applied. These factors for different frequencies may be obtained from the manufacturer of the equipment.

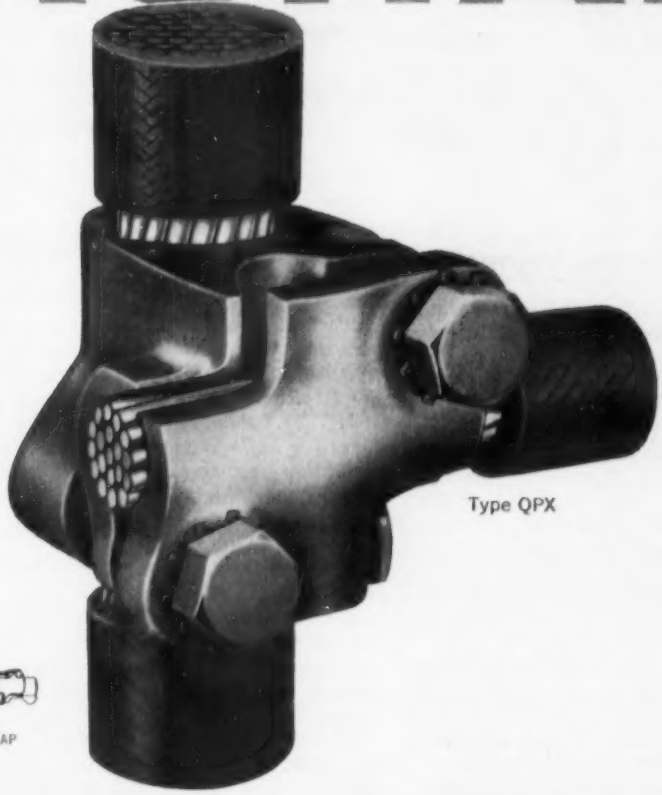
RADIO INTERFERENCE

Generation, distribution and use of high-frequency power does not,

"Brother, when they named this 'VERSITAP'..."

"...they knew what they were doing!"

VERSITAP



Type QPX

The virtues of VERSITAP:
Only a few sizes make any of 5 types of connections on cable sizes #6 through 1,000 Mcm. Easy to work; requires a minimum of stock; reusable.

SPLICE CROSS PARALLEL TEE TAP

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in any way, introduce a radio interference problem other than the interference which is normally caused by rotating equipment from the sparking of the brushes on slip rings. Good maintenance will eliminate this problem.

Power Distribution

LINE LOSSES

General distribution of high-frequency power is considerably different than that experienced in the use of 60-cycle, due to its increased reactance loss. Generally, the reactance increase above 60 cycles is directly proportional to the frequency increase.

As an example: a 60-cycle distribution line of three conductors with a reactance of 0.005 ohm per 100 ft will have a reactance of 0.01 ohm per 100 ft at 120 cycles. It is apparent, then, that the losses in a line are primarily due to its reactance. The value of resistance plays a very small part. It is also an accepted fact that as the frequency increases, the skin effect of the cable increases, wherein the current tends to travel more in the outer layers than in the center of the conductor.

CONDUCTORS

Knowing these facts, our problem then becomes: How can we distribute high-frequency power and still stay within the recommended 3% voltage drop for an ideal distribution system? Actually, there are three ways in which this can be accomplished.

First, where the voltage drop using three conductors is excessive, a parallel three-conductor line should be run connected at both ends. It must be assumed that these cables are of the same length and the same size. This, in effect, is putting impedances in parallel, thus reducing the total impedance and resulting voltage drop.

Second, the cable can be 3-conductor cable within one enclosure, which places all conductors in as close proximity to each other as is possible. This further reduces the reactance of the line.

Third, distribution may be accomplished by the use of concentric cables wherein there is one conductor in the center and another conductor on the outside. Three such conductors, properly phased, are very effective in reducing reactance.

RACEWAYS

Up to 1000 cycles, there has been little difficulty in running these distribution lines in a metallic enclosure such as conduit. With frequencies above 1000 it is advisable to run them in either non-metallic conduit or in the open, and to apply capacitors at the motor to correct the line losses due to low power factor. At 1600 cycles this is a definite requirement as the power factor drops so low that the motor will not run.

TYPICAL DISTRIBUTION

An illustration of a large successful 420-cycle power distribution system is that at the New Departure Division of General Motors Corporation in Bristol, Connecticut. Here, two 150-kw, parallel, direct connected generators are installed in the basement of a five-story building (Fig. 1). From these generators, power is distributed through parallel 4/0 cables in conduit, up a vertical well to all five floors. From the wire tower or well on each floor, a parallel main feeder distributes along the ceiling to the center of the room and towards both ends of the building.

Running parallel to these mains is a metal enclosed busway installed for flexibility and economy in connecting and disconnecting of precision ball race grinders to the high-frequency power source. The wire feeder connects into this busway at points not over 60 ft apart resulting in a maximum distance of 30 ft either side of the power tap (Fig. 2). *Busway should not be used for high-frequency power distribution for any great distance* due to the high reactance loss resulting from the spacing of the copper bus bars (Fig. 3).

Under a fully-loaded condition of the feeder with the greatest load, and at the greatest distance from the generating point, there is a 1.5% to 2.75% voltage drop. This system has given us excellent trouble-free service for many years. The 300-cycle generating and distributing system is a duplicate of our 420-cycle system and also has given us excellent trouble-free service.

RECOMMENDATIONS

For those contemplating the installation of high-frequency distribution system or equipment, and those interested in expansion, it is recommended that adequate time be spent in the complete analysis and planning of the problem prior to the purchase of equipment or its installation. This will pay dividends at a later date. Jumping to conclusions may lead to disappointment with the results obtained. Equipment manufacturers can be very helpful with high-frequency data which they will furnish.

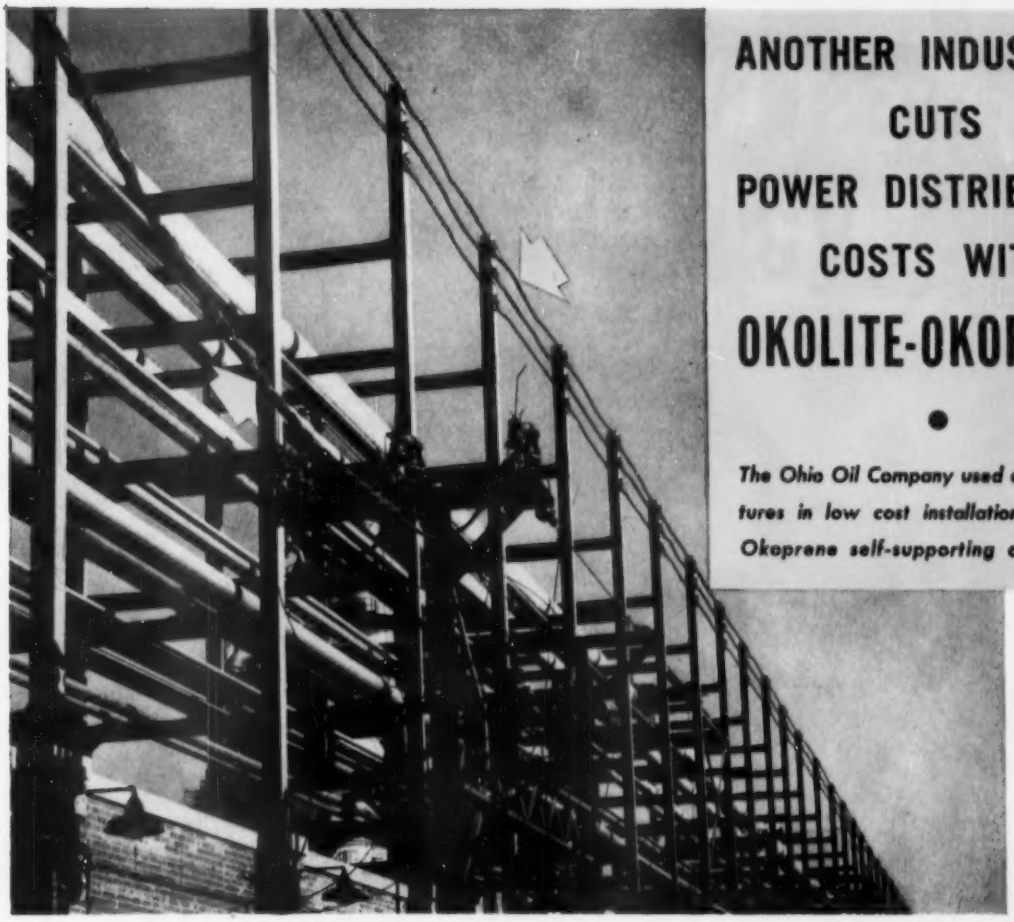
The Future

The future outlook for the generating, distributing and use of high-frequency power will be quite different from that experienced in the last 10 or 15 years. With the exception of special applications, where there is a large fixed high-frequency requirement, automation and integrated lines will dictate the use of smaller size generating units located and sized specifically for a particular production line.

Generating units used for these integrated lines will not be direct connected units but V-belt driven units on which the belts may be changed to vary the generator speed to gain a different frequency, or variable speed drives will be used to change the frequency. This means a greater number of units to maintain, but the end results of integration will warrant the application of these small units.

In the not too distant future it is very possible that an electronic unit will be developed which will be small enough in size to be installed on any one machine tool and will have the ability to vary its frequency within the range requirements of the machine. With the ability to vary frequency it will then be possible, through automatic gauging of the grinding wheel size, to increase the speed of the grinding wheel to maintain a constant surface speed per minute required for maximum production.

Progress has already been made to a degree in the use of electronic equipment for supplying high-frequency. One manufacturer has developed a centrally located electronic unit which supplies high-frequency to a group of machines. A number of different frequencies may be obtained but not at the same time to different machines. Steps such as this give promise to the future development of more practical and economical sources of power and a greater field of application.



ANOTHER INDUSTRIAL CUTS POWER DISTRIBUTION COSTS WITH OKOLITE-OKOPRENE

The Ohio Oil Company used existing structures in low cost installation of Okolite-Okoprene self-supporting aerial cables

THESE Okolite-Okoprene self-supporting aerial cables illustrate one of the most important economy features of this type of cable. At its refinery in Robinson, Illinois, The Ohio Oil Company made use of an existing pipe and conduit structure to support the Okolite-Okoprene aerial cables.

Okolite-Okoprene was widely used on this refinery installation; primary distribution from the power house to the water distribution unit substation and to the crude unit substation—in all cases the most economical use was made of existing structures.

In addition to economy in installation, Okolite-Okoprene self-supporting aerial cable provides these further advantages:

- **a higher factor of safety**
- **improved voltage regulation**
- **less space requirements**
- **high resistance to weather extremes**
- **high resistance to chemicals and acids common to industrial areas**

Okolite-Okoprene self-supporting cables have proved advantageous in virtually every industry in America. Write for Bulletin EC-1074, Okonite's complete data book on self-supporting cables. The Okonite Company, Passaic, New Jersey.

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Available with either copper or aluminum conductors

OKONITE OKONITE SINCE 1878 ***insulated cables***

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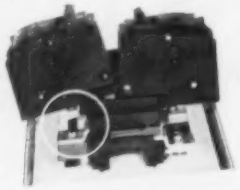
QO FINEST BREAKER EVER BUILT ...NOW IN LOAD CENTERS!

You can't go wrong!

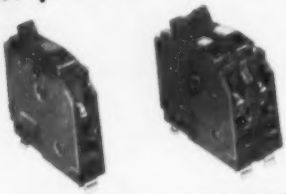
Projections on the insulated barriers prevent installation of wrong amperage breakers unless the barrier is modified. This modification is simple and can be done with a twist of the wrist.



Want to Lock It?

The spring catch can be replaced by a flush panel type lock, shown at left, by simply removing a twist-out. This lock may be "keyed" to match Square D panelboards.

Double poles go anywhere!



Shielded connectors alternate between buses, giving distributed (sequenced) phasing. As a result, two pole common or individual trip breakers can be plugged in anywhere.

• A complete line of load centers for residential, commercial and light industrial applications is already on your Square D distributor's shelf. Available with doors in 12, 20, 30 and 42 circuit basic devices—1 phase, 3 wire; or 3 phase, 4 wire. Lugs only, split bus or main breaker types. Flush, surface and raintight enclosures. UL approved and meets Federal Specifications WP-131A, Class A.

2 through 8 Circuits

For services requiring less circuits, a line of 2, 4, 6 and 8 circuit basic devices, without doors, for 1 phase, 2 wire; or 1 phase, 3 wire. Flush, surface and raintight enclosures. (8 circuit device shown at right)

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY

Practical Methods

Cleveland Installs Fluorescent Street Lighting

STREET LIGHTING

Cleveland, Ohio has added a new look to its downtown section by relighting part of its famous Euclid Avenue with fluorescent luminaires. Over one mile of this avenue, extending from Public Square to East 22nd St., now has almost double the illumination provided by the old incandescent luminaires, plus a better distribution of light and a much improved appearance at night.

The new lighting system consists of 125 Type 4FSL-72 Westinghouse fluorescent roadway lighting luminaires. These units are installed on 90-ft opposite spacings, at a 30-ft mounting height on metal poles. The street width is 60 ft. A 120-volt electrical distribution system provides power to the 2-lamp ballasts for multiple-connected operation.

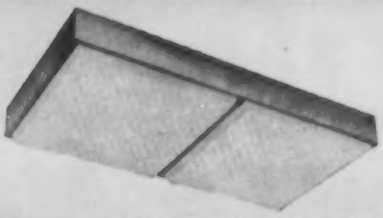
The fluorescent luminaire used houses four Type T12 72-inch cool white rapid start fluorescent lamps, operated at 1000 ma. The lamp characteristics are such, on this circuit arrangement, that the light output does not decrease with decreasing ambient temperature as normally experienced in street lighting service.

Each luminaire consists of an internal steel channel chassis which bolts to a sturdy steel mounting bracket, and to which is attached a one-piece laminated polyester fiberglass housing with color molded in so that it never requires painting.

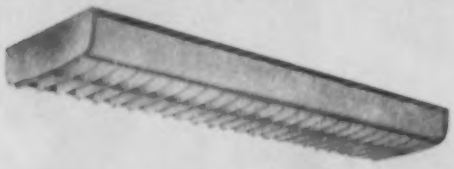
EUCLID AVENUE in Cleveland is now lighted with first installation of Westinghouse fluorescent roadway lighting units using four 72T12 cool white rapid start lamps operated at 1000 ma, to provide more than double illumination of old incandescent system at lower power consumption.

DOOR CONTROLS on post outside of large shipping doors of the Gray-Knox Marble Co. of Knoxville, Tenn., were installed by the plant electrical department to help conserve heat during the winter. Conveniently within reach of lift-truck operators (left), the switches insure the doors being closed. Truckers would be more inclined to leave doors open if they had to dismount to close the doors manually each time they passed through. Doors may also be operated by pushbuttons located on the wall (right). Duplicate controls are located inside the building.

GraybaR FEATURE



AREA/LITER has plastic diffusing panel more than twice the usual area, greatly reducing brightness, without cutting fixture light output. Provides freedom from glare, wide distribution of light, relief of monotony.



PITTSBURGH GARFIELD-ARTHUR SERIES feature shallow, sweeping lines and overall grace and beauty. Garfield series for surface mounting, flush against ceiling. Arthur units for pendant mounting with gracefully curved ends.

WILSON WIDE LIGHT is designed for fluorescent mercury vapor lamps. Achieves greater light output and efficiency with less power consumption. Ideal for "daylighting" large outdoor areas.

SILVRAY SILVER DOT furnishes controlled light, plus easy re-lamping, low lamp cost, compactness and a choice of a wide range of fixtures for any accent or general lighting.

MOE DRUM LIGHT has genuine pure white Opal Glass bowl. Easily converted to pull chain. Chromium finish.

At Graybar locations from coast-to-coast this cube hangs from *certain* lighting fixtures on display. These are Graybar *Feature Fixtures for '56!*

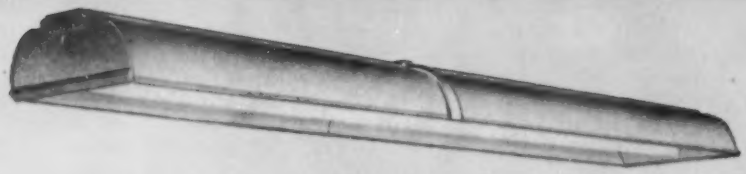
Out of hundreds of quality lighting fixtures that Graybar can offer you, ten have been selected as worthy of your particular interest and are briefly described here.

However, complete information on any or all of these lighting fixtures can be had by either phoning the nearest Graybar office, or by accepting our invitation to stop in at the nearest Graybar House and examine them at first hand. Or, use the coupon at right.

At Graybar you'll find the services of trained lighting experts to aid you and your customers in the study, planning and selection of any type of lighting system. *Whatever the lighting requirements, Graybar can impartially recommend the best lighting system for the need — from the most complete selection of lamps and lighting equipment available from any one source!*

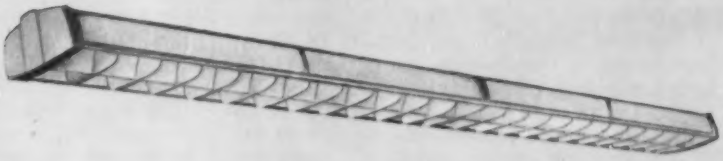
CALL GRAYBAR FIRST FOR

FIXTURES for 56!

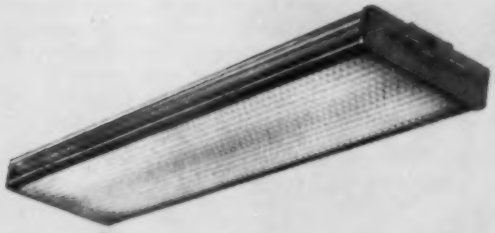


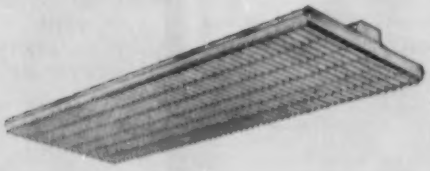
WHEELER BI-FLO UPLITER provides greater industrial seeing comfort and illumination through 28% upward light, 72% downward light. 30% cross shielding reduces glare to a minimum. Functional design eliminates dust.

BENJAMIN TWIN-FLO is ideal on the production line, in drafting rooms, testing and inspection areas, etc. Two models (open end, shown, and closed-end Stream-Flo) available for single or continuous mounting.



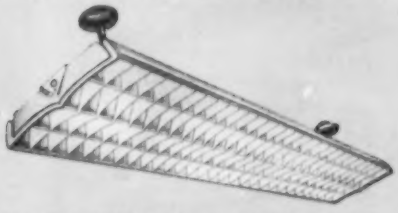
WAKEFIELD GRENADIER is ideal where fine lighting plus attractive appearance are factors. Mount as a single unit or in continuous runs. Two and four lamp models with plastic side panels.





CURTIS EDGE-GLO direct-indirect fluorescent luminaires series offer a variety of lenses and louvers for different lighting requirements. Suspend from the ceiling via hangers or mount directly to the ceiling.

SMITHCRAFT DIRECTOR fluorescent unit embodies beauty, easy maintenance, high level illumination. The eight-foot, six-light model provides over 24 square feet of light source.



DAY BRITE LUVEX-4 is designed for areas where close-tolerance work is carried on. Efficient, glare-free illumination is provided for minimum eye strain. Easy to install.

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- ☐ Silvray Silver Dot
- ☐ Smithcraft Director
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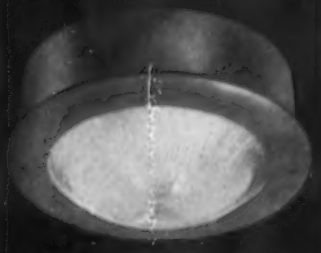

A Recessed Weathertight Downlight

Good-looking, extra shallow, rugged . . . engineered for severe weather and corrosive conditions

Entrances, canopies, lobbies, vestibules, corridors, shower rooms . . . this extra shallow recessed downlight meets all your requirements . . . where appearance is important and non-corrosiveness vital.

FACE PLATE . . . of cast satin aluminum . . . is anodized for extra weather protection . . . features the new Sealume gasket to insure weather-tight operation within the lighting unit . . . simultaneously eliminates ceiling dust streaks and light leaks visible from without.

HOUSING . . . of 16 gauge galvanized . . . can either be used as a concrete pouring form . . . or mounted in recesses already provided by using wood forms. For plaster-type ceilings, use plaster frame. Attach hinged face plate and tighten screws so Sealume gasket is compressed tight against the ceiling.

IT'S AVAILABLE with round or square diffusers providing either symmetrical or asymmetrical light distribution from 60 Watts to 300 Watts . . . **extra shallow** . . . with corresponding depths from 2½" to 6¼". Protective guards, if desired. For full data on this series, write for the "43" line.

1333 Willoughby Avenue, Brooklyn 37, N. Y.

CONSULT mcPhilben Lighting SPECIFY

Representatives in major cities

Also, there are two sheet aluminum reflectors, Alzak finish, used back to back in each unit, to redirect light from the lamps into the main beam which peaks at approximately 70° above horizontal.

An extruded DuPont lucite acrylic resin clear cover, mounted in aluminum frame, encloses the lamps and makes the unit weathertight to keep out bugs, dirt and water by means of a pressure seal against a sponge neoprene gasket. Pressure latches hold the cover on tight, make maintenance simple and easy.

Two 2-lamp ballasts control the operation of the fluorescent lamp and are connected so that each ballast operates one lamp on each side of the unit.

The luminaires are pole-mounted horizontally for a modified Type I light distribution (ASA-IES Street Lighting Standards), and can also be installed tilted to any angle between 15° and 30° for a modified Type IV light distribution.

120 Footcandles Aid Draftsmen

LIGHTING

The exacting visual requirements of draftsmen in the Design Division of the Port of New York Authority, Port Authority Building, New York City, have been aided and made easy and comfortable by a high-intensity specially tailored fluorescent lighting system. It provides an average maintained level of 120 footcandles of diffused, uniform, shadowless illumination on the drawing boards, with a minimum of brightness contrasts and reflected glare.

The new lighting system consists of 15 semi-continuous rows of plastic-shielded luminous indirect pendant luminaires, spaced 8 ft apart on centers, which run the length of the large, 45,000-sq-ft rectangular room. Each row is made up of a series of five luminaires, placed end-to-end, with 4-ft spacing between each series. This semi-continuous row arrangement was adopted to permit flexibility in office arrangement and the erecting and moving about of office partitions on column center lines.

A total of 635 luminaires are used. Each luminaire contains four 40-watt standard start warm tone fluorescent lamps, and is suspended 18 in. to the top of the unit from the 9-ft 6-in. high acoustical tile ceiling. Total wattage consumed per fixture is 200 watts, including power loss in the ballasts. The total watts per sq ft consumed is therefore 2.82, and based on the reported maintained level of illumination, the system provides a total of 42.6 footcandles per watt per sq ft.

The new lighting system was

(*Continued on page* 133)

DRAFTING ROOM of the Design Division, Port of New York Authority, is lighted to average maintained level of illumination of 120 footcandles by 635 Sylvania 4-lamp luminous indirect luminaires installed in 15 parallel rows spaced 8 ft on centers.

DEPENDABLE AIRPORT LIGHTING

System designed by Gilbert Associates, Inc., Reading, Pa.

"3 years of perfect service from over 6 miles of neoprene-jacketed cable buried direct in earth!"

Says James Evans, Airport Superintendent of General Carl A. Spaatz Field, Reading, Pa. Municipal Airport.

"In January, 1953, we buried 34,611 ft. of neoprene-jacketed primary cable directly in the earth for our runway lighting system. No problem installing it—we just ran the cable in a two-foot trench and covered it up. We haven't had a bit of trouble with the cable in over 3 years!"

Even though buried, this neoprene-jacketed cable is subjected to moisture, freezing and thawing, and temperature extremes. Neoprene's long service life under these conditions speaks well of its all-around resistance to deterioration.

You can depend on wire and cable jacketed with neoprene to cut your maintenance and replacement costs wherever they're used—above ground, in conduits, or buried direct in earth. Neoprene resists deterioration from *every* source—sunlight, heat, weathering, oil and chemicals. And remember, a neoprene cable jacket is flexible at all temperatures. Your supplier will be glad to give you full details about neoprene-jacketed wire and cable.

NEOPRENE

The rubber made by Du Pont since 1932

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

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1

268C-230

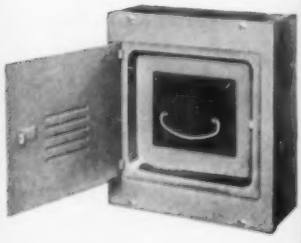
New 4-pullout device with 100 amp. main lugs and 8 plug fuse branch circuits. All four pullouts are parallel connected, with one acting as main for lighting circuits. 268C-230W offers an isolated, sealable 240 volt pullout for those areas that have "off-peak" metering for water heater circuits. Combination Flush-Surface enclosure.

2

11610S

A 100 amp. device with a 100 amp. main disconnect; 60 amp. range pullout and either 8 or 10 plug fuse branch circuits. Device has split solid neutral arrangement and bus extension lugs for easy sub-feeding. Available in either flush or surface enclosures.

3



1604

Three phase or three phase, four wire pullouts in 30, 60 and 100 amp. sizes to meet the increasing demands for three phase services. Approved for use as service equipment and ideal for air conditioning applications. Available in either flush or surface type enclosures.

Finest Products Engineered

SERVICE EQUIPMENT

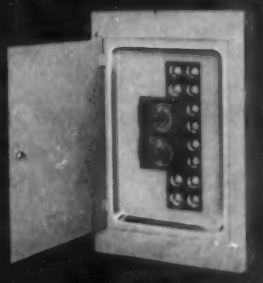
For years, Federal Pacific has offered you the only complete line of fusible service equipment from 30 to 6000 amps. Now, with the addition of six important new developments . . . Federal Pacific extends its line to meet the ever-mounting service demands of modern electrical living.

What's more, Federal Pacific equipment is engineered to slash installation costs . . . provide adequate safeguards for you and your customers.

DESIGN FEATURES THAT MAKE FEDERAL PACIFIC'S LINE THE FINEST!

- ☆ Cool efficient operation because of pressure-tight contact on Dual-lok puller heads; one-piece lug and bus bar construction.
- ☆ Extra-wide gutters without sacrifice to compactness.
- ☆ Ample knockouts for convenient wiring.
- ☆ Exclusive raintight enclosure design for easiest mounting on wall or pole surfaces.
- ☆ Enclosed live bussing and non-interchangeable pullouts for added safety.
- ☆ All pullouts clearly marked for easy identification.

4



272C

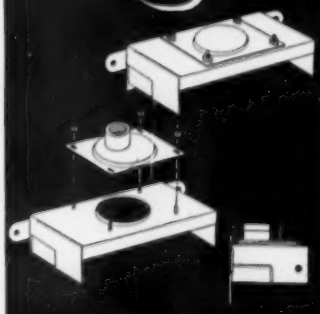
Main and range device with either 10 or 12 plug fuse branches. 100 amp. main lugs with 60 amp. pullouts in parallel. Combination flush-surface type enclosure makes conversion from surface to flush mounting a quick, easy operation.

5

120

A 200 amp. pullout for either single-phase or single-phase three wire applications. Approved for use as service entrance equipment. Where 200 amp. service is required this neat compact unit saves space and installation time. Available in either flush or surface enclosures.

6



NEW INTERCHANGEABLE HUBS FOR RAINTIGHT ENCLOSURES

For added flexibility, this exclusive Federal Pacific feature enables you to adjust hub alignment with box or meter socket WITHOUT SPECIAL FITTINGS. Available on all raintight service equipment and on safety switches through 200 amps.

FEDERAL PACIFIC ELECTRIC

COMPANY

50 PARIS STREET, NEWARK 1, N. J.

FPE
FEDERAL PACIFIC ELECTRIC

Now! FEDERAL PACIFIC PLUG-IN BUS DUCT GETS A "TOUGH", NEW HEART

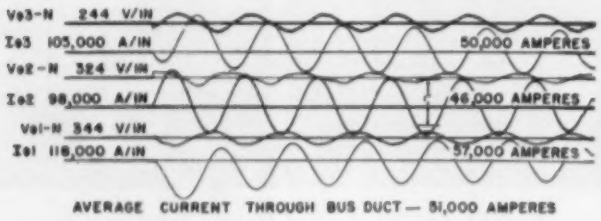
Withstands—without damage—short circuit stresses of 50,000 RMS amperes fault currents!

With this new, rugged insulator Federal Pacific adds a line of 50,000 WC* plug-in bus duct that can be directly connected to circuits capable of delivering 50,000 RMS amperes.

This new development — tested at an independent laboratory — eliminates the danger of damage to insulators, bus bars, and enclosures which is possible in modern high capacity installations. Retained, however, are all the safety advantages inherent in Federal Pacific's patented feature of "plugging-in" through the insulators.

To further prove the ruggedness of the new insulator, supplementary ARCING FAULT tests were conducted at 50,000 RMS amperes. Despite the severe arcing and heat shock incurred in this test, thorough examination showed the duct to be undamaged and subsequently it successfully passed a 2500-volt dielectric test.

*Withstanding capacity



Oscillographic record of 3-phase FAULT CURRENT WITHSTANDING test on Federal Pacific's new 50,000 WC* Plug-in Bus Duct.

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC COMPANY

50 Paris Street, Newark 1, New Jersey

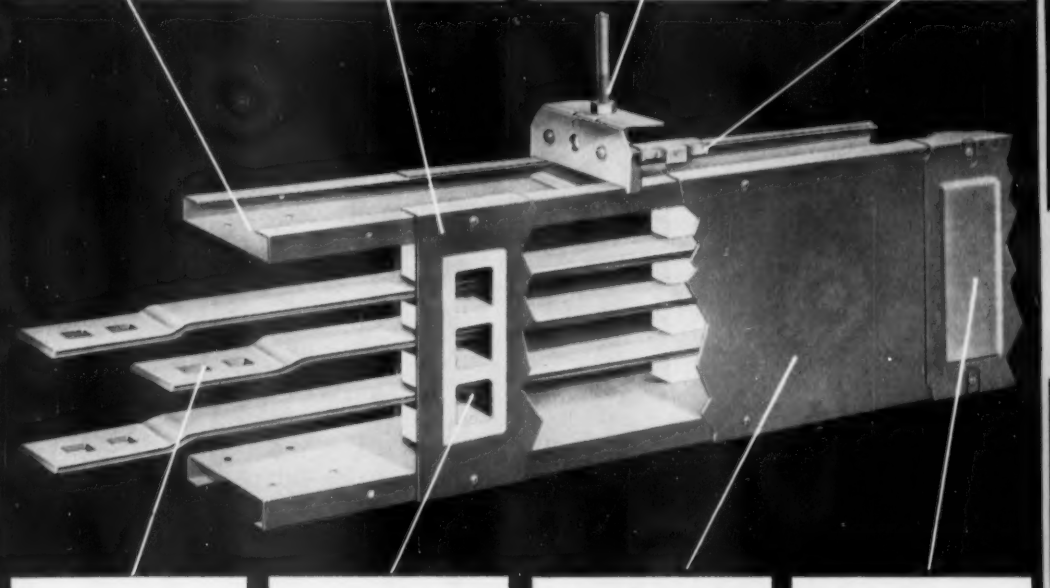
8 BIG PLUG-IN DUCT ADVANTAGES ONLY FEDERAL PACIFIC DESIGN PROVIDES THEM ALL!

1. "H" CHANNEL CONSTRUCTION—four interlocking channels... top, sides, bottom...the most rigid of all bus duct construction.

2. AMPLE PLUG-IN OUTLETS—plug-in outlets every 12 inches... simplify locating of machinery.

3. DROP-TYPE HANGER—easy to align... simplest hanging device ever developed.

4. EXTERNALLY MOUNTED SPRINGS—holds outlet covers in position at any point along duct.



5. SILVER PLATED BUS BARS—assures good contact at joints and plug-in locations.

6. INSULATED RECEPTACLES—provide safe, protected plug-in outlets... each phase isolated in its own compartment.

7. MODERN BONDING TREATMENT—coats steel enclosures with rust-resisting protective finish.

8. SLIDING COVERS OVER PLUG-IN OPENINGS—provide easy access without the aid of tools.

Plus LOW RESISTANCE JOINTS

A minimum of 2 bolts per silver-plated bus bar at the splice assures a good contact and a low resistance joint.

Plus ABSOLUTE SAFETY

Insulated plug-in openings protect maintenance men from accidental contact with live bus bars. In addition, hook-shaped safety brackets on plug-ins support the units until permanent connection can be made. Rocker-type handles on circuit breaker and safety switch plug-ins permit hook-stick operation from the floor.

Plus EXTREME FLEXIBILITY

Standard "tees", "elbows" and "offsets" permit installation around any building construction. Because of its "erector set" simplicity, additional units of Federal Pacific Bus Duct can be added with a minimum of plant shut-down.

Plus GREATER JOINT ACCESSIBILITY

Factory-fabricated sections of Federal Pacific Duct have a larger opening at the joining points than any other bus duct design. This additional working space facilitates and speeds installation.

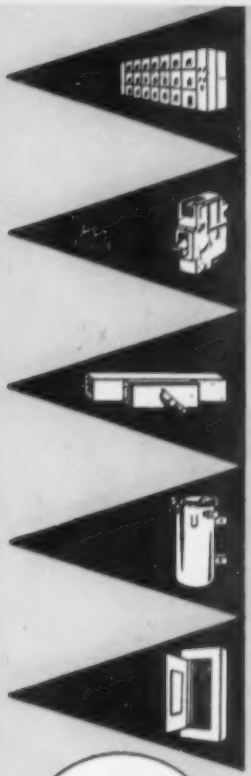
FPE
FEDERAL PACIFIC ELECTRIC

Finest Products Engineered

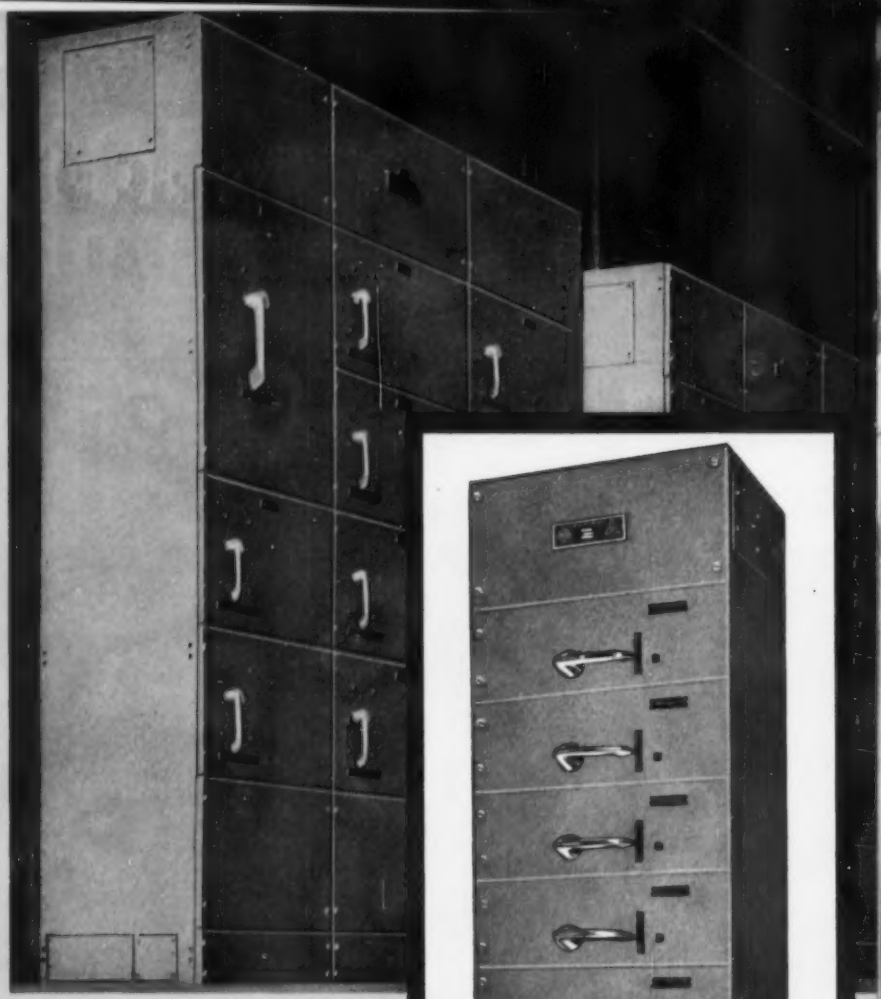
FEDERAL PACIFIC ELECTRIC

COMPANY

50 PARIS STREET, NEWARK 1, NEW JERSEY

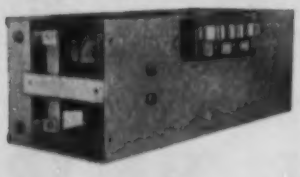


FPE
FEDERAL PACIFIC ELECTRIC



COMPACTNESS PLUS ACCESSIBILITY to circuit breakers or motor starter is secured by space-saving arrangement of components.

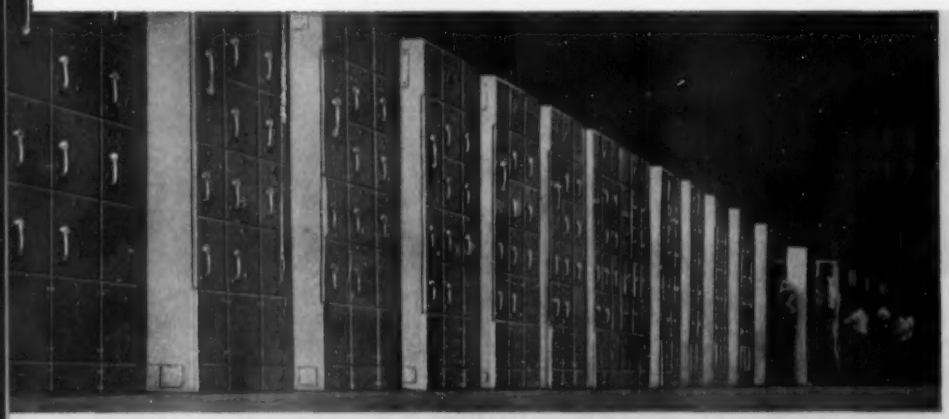
COMPACTNESS WITHOUT SACRIFICE TO SAFETY FEATURES or any of the necessary operational accessories such as push buttons, indicating lights and auxiliary relays.



HEAVY DUTY INSULATOR of high impact, low tracking material provides interphase barrier for stabs; silver copper alloy stabs reinforced with pressure springs to assure contact with both sides of bus.

UNMATCHED FLEXIBILITY. No other control center system offers such range and flexibility—Broad range of vertical section sizes, plus new 7" high compact control unit delivers the flexibility you need to meet installation requirements with maximum ease and economy.

Now! FEDERAL PACIFIC'S COMPACT MOTOR CONTROL CENTER GOES THE INDUSTRY ONE BETTER!



ASSEMBLY-LINE PRODUCTION SPEEDS DELIVERY. Standardized designs and stocking of component parts in Federal Pacific's regional plants facilitate engineering service and faster delivery.

. . . Permits As Many As 20 NEMA Size 1 Plug-in Control Units in Standard 90" High Section!

It's new! It's Compact! It's Federal Pacific! The smallest production built combination plug-in motor starter unit in the industry today! The new Federal 7" high "Compact Unit" literally doubles the number of NEMA size #1 starters that can be used within a vertical section... permits as many as twenty in a standard 90" high back-to-back section.

Ideal for use where a large number of small motors must be protected and controlled. These compact units are available in circuit breaker combination starters and with standard accessories such as "Start–Stop" push button, indicating lights, control circuit transformer, and auxiliary relay. Supplied in NEMA Class A, B or C wiring.

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC

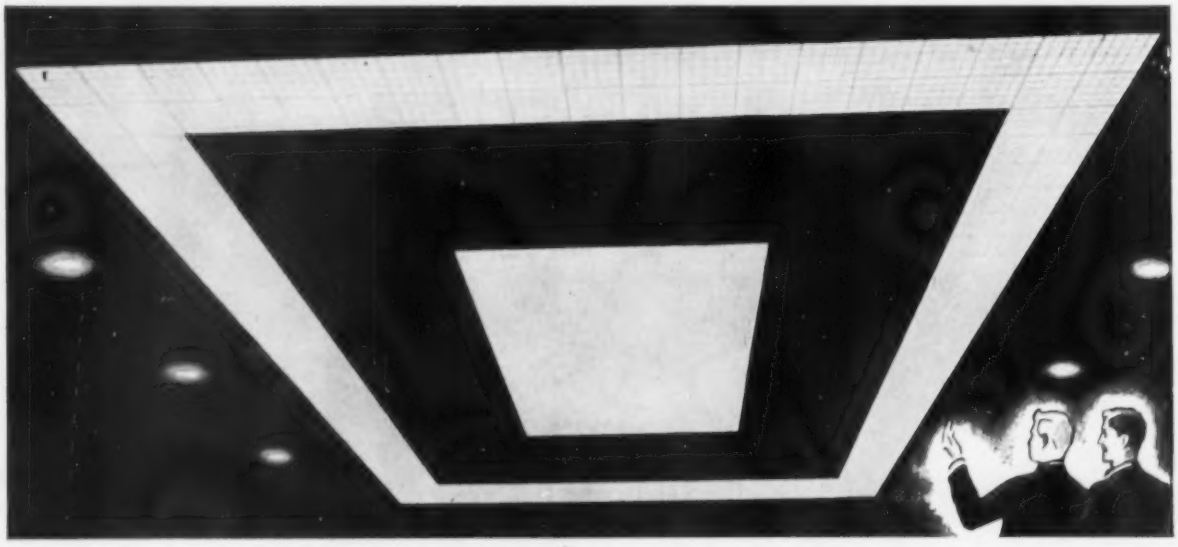
COMPANY

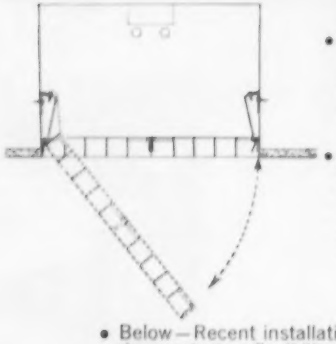
50 PARIS STREET, NEWARK 1, NEW JERSEY

There is a place for

Dramatic LUVE-TILE

in every new building . . . or re-lighting job





- "**Luve-Tile**" can be hinged down from either side or completely removed for cleaning.
- Hinging arrangement also holds the "**Luve-Tile**" firmly in position. No bars or channels are necessary.

- Below—Recent installation of "**Luve-Tile**" demonstrates flexibility and dramatic appearance.

One-foot Square Louvred Panels Offer Practical, Creative Advances Over All Other Types —Particularly for Small Areas

Versatile — handsome — highly flexible, Luve-Tile is the delight of architects, illuminating engineers, contractors.

Designed by Wilson Engineers — manufactured under Wilson patents — it is (1) Easy to assemble to suit any area; no custom-made work necessary. No horizontal bars or rosettes required. (2) Easy to maintain — rigid, light in weight — easy to remove and wash. Dirt collection is retarded — does not hold insects, foreign matter. (3) Easy on the budget — Sprinklers and air ducts are concealed and wiring and other work may be simply surface mounted. Also low-cost acoustic material may be sprayed on the cavity above the tile for sound proofing. LUVE-TILE is practical and economical to use in any area, right down to a few square feet. It is also widely used in display for special effects.

Write for Luve-Tile Catalogue section No. 8.

"Engineered WILSON Seeing"

J. A. WILSON LIGHTING & DISPLAY INC.

260 DELAWARE AVENUE, BUFFALO 2, N. Y., PHONE MOhawk 5596

IN CANADA 280 LAKESHORE ROAD, TORONTO, ONTARIO

STOCKED AND DISTRIBUTED BY LEADING DISTRIBUTORS IN THE UNITED STATES & CANADA

supplied by Sylvania Electric Products Inc., and is their Type CP-442 Trimline series. It replaces an old lighting system which provided a range of from 25 to 55 footcandles. Installation of the new lighting system was by Dinsen & Co., New York electrical contractors.

Visual Aids Are Effective Sales Tools

MANAGEMENT

Visual demonstrations effectively illustrate verbal presentations, hold the interest of clients, back up general statements with specific facts, and frequently mean the difference between winning or losing sales. This is the belief of Ed Creed, C & S Lighting Maintenance Company, Cleveland, Ohio. As a result, Ed uses visual aids extensively when discussing features of lighting maintenance with any of his customers, prospects or even with the men in his shop.

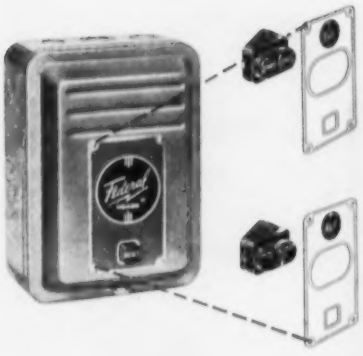
For example, he used a compact 2-lamp fluorescent reflector equipped with extension cord and separate switches for the two lamps, to demonstrate the color differences between cool and warm white, standard or deluxe tubes. As indicated by the accompanying photograph, this simple unit consists essentially of sheet metal wrapped and tacked around parabolic wooden end pieces, then painted a flat white on the inside to provide even and adequate reflectance. When not in use, the extension cord may be neatly coiled over large hooks screwed into the two wooden end caps, and an assortment of different colors of lamps may be carried along to stress whatever point is being emphasized or recommended.

Another useful visual aid is his always-carried light meter, for prospective customers generally seem to be more impressed with a pointer and scale than with hundreds of words or statements. The

ED CREED of C & S Lighting Maintenance Company checks his portable demonstration kit before visiting a customer to discuss relative color values and resultant effects of various fluorescent lamps. Compact 2-lamp reflector is equipped with separate switches for the lamps and with an extension cord which may be coiled up neatly inside the reflector when not needed.

OUTDOOR CONDUIT STORAGE racks sheltered by a roof save valuable indoor space for the Tennessee Armature and Electric Co., Knoxville, Tenn. Conduit is stacked vertically for easy handling, occupying a minimum of space, and permitting sufficient stock to be kept on hand for quick shipment to job sites as needed. Bordering the parking area, it speeds loading onto trucks.

FEDERAL PACIFIC adds new flexibility to MOTOR CONTROLS!



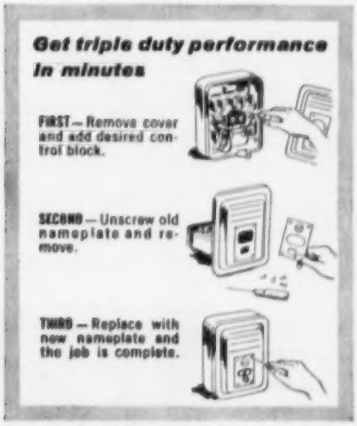
Three-way application with this single unit!

Convenient...simple...time conserving...the new Federal Pacific Motor Starter Conversion Kit literally permits triple duty performance from NEMA 1 enclosures size 0 through 3—allows each to perform as either remote control (Form I), local control (Form II) or selector switch (Form III) motor starters!

SIMPLIFY INVENTORY—simply stock the basic starter plus Form II and Form III conversion kits and you can meet motor starter requirements up to NEMA size 3.

QUICK SIMPLE CONVERSION—no necessity to punch out or knock out holes to facilitate conversion. The facilities are designed into the unit.

COLOR CODED WIRING—color coding eliminates confusion...makes wiring a quick, simple operation.


Get triple duty performance in minutes
FIRST—Remove cover and add desired control block.
SECOND—Unscrew old nameplate and remove.
THIRD—Replace with new nameplate and the job is complete.

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC
COMPANY
50 Paris Street, Newark 1, N. J.

Nearest Thing to Conduit Threading by Machine

RIDGID

Jam-Proof 65R

saves you time, work and mistakes

Ready for work fast — you set 65R to conduit size in 10 seconds . . . self-contained 1", 1¼", 1½", 2" high-speed steel dies. Self-centering workholder sets to size instantly.

No mistakes — automatic kick-out prevents jamming when standard thread is cut. Workholder setting is mistake-proof.

Beautiful threads — perfectly threaded factory test sample in your new 65R proves it!

You can't beat RIDGID 65R for speed, easy work and long service. *Buy it at your Supply House!*

RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U. S. A.

light meter also gives visual proof of a maintenance job well done, for "before and after" cleaning readings show conclusively that illumination levels have definitely been improved by relamping, washing or correcting faults in the lighting system.

Still another visual aid, found in the C & S shop, is a wall chart of Cleveland and the surrounding countryside. Lettered and numbered along sides and top, it is a rapid procedure to cross-reference the map to an adjacent street index. Then, by stretching a tape (which is graduated to the same scale as the map and is pivoted from the approximate position of the C & S shop) to the desired street address, it is possible for Ed to show his drivers and crew foremen the destination of a service call, visually show them the general direction to the call, estimate the approximate mileage which will be traveled, and therefore estimate the time required to drive to and from the customer's premises.

High School Installs Electric Scoreboard

ELECTRIC SCOREBOARD

Spectators, officials and basketball players in the Colonie (N. Y.) High School gymnasium can keep up on the score and minutes left to play by referring to one of two 4- by 6-ft electric scoreboards that flank the court in that modern recently constructed school. The board is equipped with a 32-in. sweep-second and jump-minute clock, four banks of 28 lamps (4

THE SCORE, the time and the period can be instantly ascertained by glancing at one of the electric scoreboards in the Colonie (N. Y.) High School gymnasium. Control of the panels is through 30-conductor cables paralleled at a press-gallery control center.

Demonstrated in the laboratory

proved in the field

Du Pont ALATHON® has 27% superior abrasion resistance

POLYETHYLENE RESIN

Superior abrasion resistance is one important reason why "Alathon" polyethylene resin gives outstanding performance as an electrical jacketing and insulating material.

The extra toughness and durability of insulation and jacketing of Du Pont "Alathon" were dramatically demonstrated in the laboratory by means of a scrape test. A reciprocating blade set perpendicular to the jacketing abraded ordinary polyethylene from the conductor after 341 cycles. Under the same conditions, the wire jacketing of "Alathon" withstood the blade action through 433 cycles—an increase of 26.9%. Final proof, of course, comes in the field where "Alathon" provides more years of trouble-free service.

In addition to superior abrasion resistance, "Alathon" features low power loss and low dielectric constant, flexibility even at extremely low temperatures and outstanding moisture, chemical and heat resistance.

With insulation and jacketing of "Alathon," you get cable that is light in weight, flexible and easy to handle. Installation is speeded by its ease of pulling, cleanliness in handling, and simplified jointing and terminating requirements. To get complete property and application data on "Alathon," clip and mail this coupon.

There is a difference in polyethylenes . . . insist on insulation and jacketing of ALATHON®

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 446, Du Pont Building, Wilmington 98, Delaware

In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Please send me complete information on Du Pont "Alathon" polyethylene resins. I am interested in evaluating these materials for

_____

Name _____

Position _____

Firm Name _____

Street Address _____

City _____ State _____

Type of Business _____

NEW STONCO

NO. 64 FLOOD:

121,000 cp

for only

500 watt rating

- **Double the Lamp Life**
- **Faster Heat Dissipation**
- **Rain-tight**
- **High Intensity**

LONG THROW NARROW BEAM—
Especially effective for long range floodlighting of railroad and freight yards, piers, docks, golf driving ranges – or where floods must be mounted at a considerable distance from the area to be illuminated . . .

WIDE AREA COVERAGE—
Available with wide beam for brilliant, economical floodlighting of large, wide areas such as baseball and football fields, racetracks and industrial areas . . .

Here is a powerful, new outdoor floodlight that concentrates its light in a long-throw, oval-shaped beam that produces over 121,000 candlepower with only a 500 watt rating – almost twice the maximum beam candlepower of general service lamps in the most efficient reflectors. And the lamp life is rated at 2,000 hours – double the normal life of standard lamps in average use.

Stonco No. 64 is precision cast aluminum throughout, and carefully engineered with heavy internal as well as external ribs to provide double the normal surface area for faster heat dispatch. To guard against shock the lamp is cradled in high-temperature rubber and to seal the unit rain-tight and water-tight for use in any position (even face up) the lamp is doubly protected with rubber gaskets.

The No. 64 floodlight also is available as a portable or wall type unit. A complete line of interchangeable wiring troughs, splice boxes, wall and pole fittings for mounting cluster combinations makes it highly effective for many multiple applications.

Get the facts on the new No. 64—send for Bulletin No. 140.

LAMPHOLDERS

CLUSTER LIGHTS

VAPORTIGHT

ISLAND LIGHTS

For outdoor lighting - It's Stonco

Stonco

ELECTRIC PRODUCTS CO.
Kenilworth, New Jersey

lamps wide and 7 high) to indicate the score, four luminous markers to indicate the period, and an electric horn to announce time-outs and end of play. All pertinent information related to the game can be assimilated in a split-second glance. Boards, approximately 6 in. in depth, are completely enclosed, are controlled by means of 30-conductor 16-gauge cables, and are powered through No. 10 wire circuits.

The multiple-wire control cables are paralleled at a control center located in the press gallery, this center being equipped with toggle switches for starting, stopping and resetting the timing dials, signal pushbuttons for manual operation, and rotary switches to operate the period lamps. Cables between press gallery and scoreboard locations are carried in conduit, with actual connections made via 30-contact plug assemblies.

The boards have proved to be 99% satisfactory, the remaining 1% of inadequacy being attributed to sharpshooting accuracy of players rather than to electrical inaccuracy of panels. However, these occasional sharpshooting binges, resulting in the creation of 3-digit scores, seem to cause little annoyance to players and rooters for the winning school.

WOODEN PLATFORM spanning the entire floor area of the New York Coliseum formed a safe working area for the installation of electrical conduit, busways, air conditioning ducts and lighting fixtures, as well as the equipment of the other trades. Steel trusses ranging from 12½ to 21 ft in depth which support the Coliseum roof were used as the framework for the platform (seen here from below), which was constructed over the top of the lower truss members. Contractors were T. Frederick Jackson, Inc. and J. Livingston & Co., New York.

WIRE BY PHELPS DODGE

New York's newest and finest show place is the 35-million-dollar Coliseum and adjoining 20-story office building. The four-story Coliseum provides the most modern facilities available anywhere for trade shows, exhibitions and conventions of all kinds.

This impressive hall is another of the outstanding structures throughout the country in which Phelps Dodge wire and cable was selected to assure safe, dependable electric service.

Approximately 285 miles of Phelps Dodge wire and cable supply current for the brilliant interior lighting —lighting twice as bright as that of the average office.

* * *

On every wiring job, large or small, where top-quality materials, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

347 Local General Electric Distributors Announce . . .

"OFF-THE-SHELF" DELIVERY OF G-E

NOW—347 G-E motor Distributors throughout the country have increased their stocks to give motor buyers faster delivery of G-E Tri-Clad* '55' motors. They now carrry a complete line of Tri-Clad motors—listed at right—to keep your down time at a minimum and to help cut your standby inventory. Dial your local G-E Distributor today. His name and phone number are listed on the following pages. Call him now and he'll send you a handy Tel-Eze phone index—FREE.

*Registered trademark of General Electric Co.

© 1956, General Electric Co.

FREE GIFT! Call your local G-E motor Distributor to learn how you get faster delivery on Tri-Clad '55' motors 5 to 20 hp and larger. He'll also send you this handsome Tel-Eze phone index as a gift. Fasten it right to your phone. It's handy—useful—never in the way. (Supplies limited—call today.)

MOTORS 5 TO 20 HP

LISTED DISTRIBUTORS STOCK THESE MOTORS AND OTHERS IN SMALLER AND LARGER SIZES

HP	RPM	ENCLOSURE	HP	RPM	ENCLOSURE
5	1200	Dripproof	10	1800	Enclosed
5	1200	Enclosed	15	1800	Dripproof
7½	1800	Dripproof	15	1800	Enclosed
7½	1800	Enclosed	20	1800	Dripproof
10	1800	Dripproof	20	1800	Enclosed

All motors are standard, 60-cycle, 3-phase, Type K, ball-bearing models.

CALL ME NOW!

ALABAMA
BIRMINGHAM
Argo & Co.
H. B. Williams, 57-4652
Matthews Elec. Supply Co., Inc.
Roy Norrell, AL 4-3192
MOBILE
Turner Supply Co.
V. B. Heath, HE 8-5581

ARIZONA
PHOENIX
Garrett Supply Co.
Frank Jordan, AL 8-5701
General Elec. Supply Co.
Gene Genon, ALpine 8-6721
Graybar Elec. Co., Inc.
Paul Bradford, ALpine 2-2371

ARKANSAS
CROSSETT
Tri-State Mill Supply Co.
J. P. Holland, FO 4-4136
FORDYCE
Tri-State Mill Supply Co.
J. B. Dooley, 301
LITTLE ROCK
General Elec. Supply Co.
G. M. Thompson, FR 5-5328
Graybar Electric Co.
Julian Smith, FR 5-1246
O'Bannon Bros.
W. F. Lewis, FR 2-2211

CALIFORNIA
BAKERSFIELD
Gough Industries, Inc.
Gene Duke, FA 5-5907
EMERYVILLE
General Elec. Supply Co.
Chris Misner, OL 3-4433
EUREKA
A. Brizard, Inc.
W. Nelson, HI 2-3761
FRESNO
Electric Motor Shop
3-1154
General Elec. Supply Co.
Bert Kelley, 8-4711
LOS ANGELES
California Wholesale Elec. Co.
John Cook, RA 3-7131
Garrett Supply Co.
Bob Dick, LU 6-7221
General Elec. Supply Co.
Paul R. DeBroux, Madison 5-7141
Gough Industries, Inc.
Charles Beaver, MA 6-2474
W. W. Grainger, Inc.
Charley Tamarkin, AN 3-6928
Graybar Elec. Co.
AN 3-7282
Shields, Harper & Co.
W. E. Kite, LO 8-4931
Smallcomb Elec. Co.
C. T. Truman, Richmond 7-0221
Ulrey & Gillett
Ed. Hetzer, RI 9-3051
MAYWOOD
Mitchell Elec. Equip. Co.
M. S. Mitchell, LU 3-4818
NORTH HOLLYWOOD
Dyer's Elec. Supply, Inc.
Frank Muhleman, FO 5-5434
OAKLAND
California Elec. Co.
Walter Vance, OL 5-6100
Shields, Harper & Co.
J. F. Mitchell, OL 3-9119
William Wurzbach Co.
Wm. Wurzbach, AN 1-0217
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Gerlinger Steel & Supply Co.
Frank Gerlinger, 2330
SACRAMENTO
Capital Machine & Welding Wks.
M. Horat, GI 3-2556
General Elec. Supply Co.
E. A. Reimers, GI 3-9001
SAN BERNADINO
General Elec. Supply Co.
R. W. Morgan, 5135
SAN FRANCISCO
General Elec. Supply Co.
Frank King, UN 3-4000
Kuchel & Sievers Elec. Wks, Ltd.
F. O. Sievers, UN 1-8261
STOCKTON
General Elec. Supply Co.
Rod Elton, HO 5-7231
Guntert & Zimmerman Sales Div., Inc.
Ralph Warfield, HO 4-8712
UKIAH
Klamath Machine & Locomotive Wks., H. Ettrem, HO 2-6578
VAN NUYS
So-Cal Equip. & Supply Co.
Dick Sanford, ST 5-5431

COLORADO
DENVER
General Elec. Supply Co.
AM 6-0671

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GENERAL ELECTRIC

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(Continued from preceding page)

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TA 5-7116
Hendrie & Bolthoff Co.
Keystone 4-4111
GRAND JUNCTION
General Elec. Supply Co.
4524
PUEBLO
Johnson Elec. Co.
R. S. Johnson, LI 3-1746

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BRIDGEPORT
Elec. Maintenance Serv. Co., Inc.
Ed Burr, ED 3-6163
General Elec. Supply Co.
T. E. Rassmussen, FO 8-1621
MERIDEN
Conn. Elec. Equip. Co.
F. L. Raynor, BE 5-6383
WEST HARTFORD
Graybar Elec. Co., Inc.
W. Treanor, AD 3-2631

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WILMINGTON
Artcraft Elec. Supply Co.
E. J. Read, Olympia 6-6651
General Elec. Supply Co.
Cliff Clark, Wilmington 5-5561

DISTRICT OF COLUMBIA
WASHINGTON
General Elec. Supply Co.
E. Czyz, HU 3-6800

FLORIDA
JACKSONVILLE
General Elec. Supply Co.
EL 3-9011
Turner Elec. Works
O. K. McQuaig, EL 3-3661
MIAMI
General Electric Supply Co.
NE 5-1361
Gondas Corporation
FR 4-1745
TAMPA
General Electric Supply Co.,
2-1805
Raybro Elec. Supplies, Inc
W. D. Young, 2-1921

GEORGIA
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Cleveland Elec. Co.
P. W. Pullin, JA 4-8422
General Elec. Supply Co.
V. T. Baldwin, Jr., MU 8-3811
AUGUSTA
Elec. Equip. Co.
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General Elec. Supply Co.
J. W. Bond, 6-8422
CAIRO
Harrison & Ellis Co.
E. B. Harrison, 2-4482
DALTON
Dalton Supply Co.
Alfred Bailey, 1564
ROME
Battey Machinery Co.
G. B. Burkhalter, 2-2421
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General Elec. Supply Co.
Dick Peters, 4-2231
VALDOSTA
Valdosta Armature Wks.
A. L. McMillan, 1732

IDAHO
BOISE
General Elec. Supply Co.
J. Lees, 4-5541
Graybar Elec. Co., Inc.
W. C. Coon, 2-4501
PARMA
Transmission Products, Div of
Parma Water Lifter Co.
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A. A. Electric Supply Co.
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Cesco Equip. Co.
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Efengee Elec. Supply Co.
Sy Harris, SE 8-3500
Excel Elec. Service Co.
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General Elec. Supply Co.
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Metropolitan Elec. Supply Co.
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Illinois Elec. Works
Willis Harszy, UP 5-4321
MT. VERNON
Dowzer Elec. Machinery Wks, Inc.
Rex V. Woodward, 190
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Graybar Elec. Co., Inc.
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General Elec. Supply Co.
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Kelly Graham, 8-0484
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Cresent Elec. Supply Co.
T. R. Huston, 2674

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Swanson Nunn Elec. Co.
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General Elec. Supply Co.
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Nussbaum Elec. Co.
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Graybar Elec. Co., Inc.
Andy Sarti, Tilden 4-7800
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Graybar Elec. Co., Inc.
M. P. Kirsch, ME 8-2351
SOUTH BEND
Koontz-Wagner Elec. Co., Inc.
H. B. Kumm, Central 3-8251

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Crescent Elec. Supply Co.
F. J. Hemann, PL 2-3631
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Crescent Elec. Supply Co.
Lea Plotz, 3-9601
DAVENPORT
Crescent Elec. Supply Co.
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L. E. Morse, AT 2-0431
General Elec. Supply Co.
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Crescent Elec. Supply Co.
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WATERLOO
Crescent Elec. Supply Co.
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PITTSBURG
Atkinson Armature Works
Frank Horton, 1754
WICHITA
General Elec. Supply Co.
Jim Owens, AM 5-0627

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HARLAN
General Elec. Supply Co.
Bud Thompson, 815
LEXINGTON
General Elec. Supply Co.
Paul E. Hines, 2-1887
Graybar Elec. Co., Inc.
L. W. Wester, 5-2020
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Mine Service Co.
Phone 239
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Jack Mattingly, ME 7-3651
Graybar Elec. Co., Inc.
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Marine Elec. Company
Melvin Theobald, Juniper 4-7175

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ALEXANDRIA
Brown Roberts Elec. Co.
Mack King, 3-7281
BATON ROUGE
General Elec. Supply Co.
G. F. Schilling, 7-7586
Graybar Elec. Co., Inc.
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Harvey Wager, Galvez 5771
Graybar Elec. Co.
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John Berger, Canal 9566
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A. W. Herbert, CA 6641
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General Elec. Supply Co.
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Graybar Electric Co., Inc.
J. L. Roberson, 5-3271

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PORTLAND
General Elec. Supply Co.
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WESTBROOK
Stultz Elec. Works
Robert Webb, UL 4-2501

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General Elec. Supply Co.
George Smorse, LE 9-3565
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P. J. Curreri, SA 7-5050
HAGERSTOWN
General Elec. Supply Co.
A. L. Daly, 6216
Hagerstown Equip. Co.
Allen E. Ocker, 3813

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General Elec. Supply Co.
Carl Jackson, AL 4-5300
Graybar Elec. Co., Inc.
George Milligan, KE 6-4567
Sandman Elec. Co., Inc.
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FITCHBURG
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Des Roberts Elec. Supply Co.
G. W. Knowlton, Lynn 5-0015
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General Elec. Supply Co.
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WORCESTER
General Elec. Supply Co.
Francis Cross, Pleasant 6-4351

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Mid-States Elec. Supply Inc.
R. E. Hartmann, WO 3-6635
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Frank C. Teal Elec. Co.
Victor L. Kochajda, LO 8-9092
General Electric Supply Co.
O. C. Hall, TR 5-9400
Graybar Elec. Co., Inc.
TO 8-5550
Miller-Seldon Elec. Co.
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Spaulding Elec. Co.
A. P. Schaupner, WO 2-6200
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C. R. Hechinger, Sunset 9-9101
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Clement Elec. Distributing Co.
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General Elec. Supply Co.
D. A. Harper, Glandale 9-3243
Graybar Elec. Co., Inc.
GL 1-2701
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Elec. Wholesale Supply Co.
P. Spry, 2-7123
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G. E. Merrington, 3-2645
LANSING
Barker-Fowler Elec. Co.
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Graybar Elec. Co., Inc
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2-6621
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General Elec. Supply Co.
N. C. Stuart, 3-6474

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Graybar Elec. Co., Inc.
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Bob Borg, FE 8-7531
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Graybar Elec. Co., Inc.
Wayne Aceto, JE 1-4700

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General Elec. Supply Co.
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BUTTE
Graybar Elec. Co., Inc.
Dick Murtha, 3233

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General Elec. Supply Co.
Tom Ridgeway, Jackson 0456
Graybar Elec. Co., Inc.
Fred B. Hanson, Webster 7676
Schneider Elec. & Equip. Co.
W. J. Andersen, Webster 5550

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RENO
Linnecke Elec. Sales Co.
W. R. Reynolds, Reno 3-3729

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MANCHESTER
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Joe Charron, NA 5-5418

GENERAL ELECTRIC

SHELF" DELIVERY OF G-E MOTORS 5 TO 20 HP

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National Elec. Supply Co.
Meyer Borstein, Emerson 5-4330
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General Elec. Supply Co.
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A. Bishop Elec. Motor Exchange
Arnold Bishop, KI 5-6446
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General Elec. Supply Co.
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Watson-Flagg Sales Corp.
E. M. Koetsier, LA 5-2324
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General Elec. Supply Co.
Ray Jamieson, Owen 5-3453
Thropp Elec. Sales Corp.
C. W. Archinal, JU 7-1441

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A. E. Boyd Equipment Co.
4-6016
Electric Service, Inc.
2-9447
General Elec. Supply Corp.
2-5246

NEW YORK
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Graybar Electric Co., Inc.
5-1563
Havens Electric Co., Inc.
4-1201
BUFFALO
General Electric Supply Co.
R. H. Sheldon, EL-5100
Graybar Electric Co., Inc.
Lou Pfeffer, WA-3700
BROOKLYN
Apparatus Distributor, Inc.
Len Keller, UL 2-4000
ELMIRA
Le Valley McLead, Inc.
John F. Decker, 6163
GLENS FALLS
Glens Falls Electric Supply Co., Inc.
2-5868
JAMAICA
Central Queens Elec. Supply Corp.
Charles Weltner, RE 9-2020
LONG ISLAND CITY
Graybar Elec. Co., Inc.
L. H. Kort, EX 2-2000
Motors & Armatures, Inc.
Sid Davis, EX 2-3523
NEW YORK
Electric Motors Corp.
M. Goldberg, CA 6-4665
General Elec. Supply Co.
Jim Bayland, AL 5-3300
W. W. Grainger, Inc.
E. Heckler, CA 6-3810
Hudson Elec. Sales Co., Inc.
D. Hark, WO 2-3041
POUGHKEEPSIE
Electra Supply Co., Inc.
Howard K. Phillips, 8000
ROCHESTER
Electric Equip. Co. Div.
Norry Elec. Company
GL-6070
General Elec. Supply Co.
Dan Nolan, HA 7500
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HA-9840
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M. H. Salmon Elec. Co., Inc.
R. S. Bowser, 73-3325
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Tri-State Elec. Motors, Inc.
D. W. Fitzpatrick, Ashley 2-4250
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Langden & Hughes Elec. Co., Inc.
C. A. Dyer, 4-3154
Mather, Evans & Diehl Co., Inc.
Bill Diehl, 4-6165

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A. L. Henderson, 2-4481
CHARLOTTE
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J. B. Hurt, Jr., FR 5-7321
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FAYETTEVILLE
General Elec. Supply Co.
T. C. Merritt, 2-5143
GREENSBORO
General Elec. Supply Co.
John F. Alexander, 3-8207
GREENVILLE
General Elec. Supply Co.
Bob Prevatte, 5104
LAURINBURG
Electrical Equip. Co.
H. A. Gill, 1196
RALEIGH
Electrical Equipment Co.
W. T. Becton, TE 2-2039
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WINSTON-SALEM
Graybar Elec. Co., Inc.
D. W. Terry, 4-2461

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Graybar Electric Co., Inc.
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Jackson-Bayley Electric Co.
W. Bayley, Jr., GL 5-9421
CINCINNATI
General Elec. Supply Co.
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MA 1-0600
CLEVELAND
Elliott Electric Co.
F. G. Allan, TO 1-2454
General Elec. Supply Co.
Len Burns, HE 1-7280
Graybar Electric Co., Inc.
G. W. MacCarter, HE 2-2500
Strong, Carlisle & Hammond Co.
Jim Simmons, TO 1-8800
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General Elec. Supply Co.
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Graybar Electric Co., Inc.
L. C. (Lou) Bagent, CA 8-3811
The Loeb Electric Co.
Marion Klacki, AX 9-1142
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General Elec. Supply Co.
MI 0781
Graybar Elec. Co., Inc.
MI 5665
HAMILTON
The Wente Elec. Co.
TW 4-8128
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General Elec. Supply Co.
3-2341
TOLEDO
General Elec. Supply Co.
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Economy Electric
E. Cutler, Jr., Riverside 4-4461
General Electric Supply Co.
C. B. Monroe, Riverside 6-6511
Graybar Elec. Co., Inc.
George Rowlands, Riverside 4-0124

OKLAHOMA
DUKE
I. V. Owen Co.
Ronald Owen, 72
OKLAHOMA CITY
Graybar Elec. Co., Inc.
Jim Cavanaugh, FO 5-9351
TULSA
General Electric Supply Co.
F. G. Ross, DI 3-6121
Graybar Elec. Co.
Ray Downing, MA 6-2121
WEWOKA
Okla. Ind. Elec. Supply Co.
Jim Embach, 287

OREGON
COOS BAY
Marshfield Elec. Co.
U. E. Richter, Congress 7-6319
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American Steel & Supply Co.
R. E. Yates, Diamond 5-0373
KLAMATH FALLS
Klamath Mach. Co.
H. Ellis, 2-2588
MEDFORD
American Steel & Supply, Inc.
R. S. Rix, 2-7181
General Elec. Supply Co.
P. Jorgenson, 3-4519
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Eoff Electric Co.
CA 2-9411
General Elec. Supply Co.
CA 7-0651
Graybar Elec. Co., Inc.
CA 7-6641
Holt & O'Donnell
CA 8-0753
ROSEBURG
Industrial Elec. Service Co.
L. Hobart, OR 3-6658

PENNSYLVANIA
ALLENTOWN
Allen Elec. Co.
L. Brown, HE 5-9515
General Electric Supply Co.
Bob Harte, Hemlock 3-5206
BRADFORD
Bovaird & Co.
L. V. Brown, 7141
DREXEL HILL
General Elec. Supply Co.
F. Robinson, CL 9-6440
ERIE
General Elec. Supply Co.
Al Weirich, 2-1477
INDIANA
National Mines Service Co.
5-5655
JOHNSTOWN
General Elec. Supply Co.
W. C. Hill, 7-5101
LANCASTER
Raub Supply Co.
G. E. Brown, 7-6221
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Eugene Batdorf, MA 7-1895
General Elec. Supply Co.
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Graybar Elec. Co., Inc.
P. D. Chick, WA 2-5405
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Ray Gillin, WA 2-2241
PITTSBURGH
General Elec. Supply Co.
D. J. Finn, Fairfax 2-1530
Graybar Elec. Co., Inc.
Mark Glusgow, FA 2-4100
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Westchester Elec. Supply Co.
R. McLaughlin, WE 4722
WILLIAMSPORT
Lowry Electric Co., Inc.
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General Elec. Supply Co.
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RHODE ISLAND
PROVIDENCE
General Elec. Supply Co.
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J & H Electric Co.
Calvin Wilcox, GA 1-7840
PAWTUCKET
N. E. Elec. Supply Co.
Pawtuckett 5-7400

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ANDERSON
Woodward-Stephens Co., Inc.
D. Fred Stephens, CAnal 5-2501
GREENVILLE
J. W. Vaughan Co.
Newell Eastland, 2-2421
SUMTER
Sumter Machinery Co.
B. A. Siddall, SPruce 3-7321

SOUTH DAKOTA
ABERDEEN
McLaughlin Elec. Supply House
Don Lehr, 4911
RAPID CITY
Crescent Elec. Supply Co.
T. R. Hersey, FI 2-7913

TENNESSEE
CHATTANOOGA
Elec. Motor Sales & Supply Co.
Frank N. Griscom, Jr., 9-7361
Graybar Elec. Co., Inc.
Max Evans, 4-3351
COLUMBIA
Middle Tenn. Armature Wks.
R. Cleveland, EV 8-3672
MEMPHIS
Graybar Elec. Co., Inc.
Jim Branson, BR 8-7150
Tri-State Armature & Elec. Wks.
W. W. Bumpus, JA 7-8414
NASHVILLE
Industrial Sales Co., Inc.
N. G. Welch, Alpine 4-3508
Nashville Armature Co.
Alpine 6-2546

TEXAS
ABILENE
General Elec. Supply Corp.
Ray Alexander, 2-2827
Graybar Elec. Co., Inc.
Buck Buchanan, 2-2861
AMARILLO
General Elec. Supply Co.
B. D. Garrett, DR 6-7254
Graybar Electric Co., Inc.
G. N. Barker, DR 2-6778
BEAUMONT
General Elec. Supply Co.
Arlan Young, 4-6435
CORPUS CHRISTI
Bradley Motor & Armature Works
Ernest B. Williamson, TU 2-8891
General Elec. Supply Co.
W. D. Clarke, TU 2-9237
Graybar Elec. Co., Inc.
M. J. Smith, TU 4-6374
DALLAS
General Elec. Supply Co.
Ollis W. Walden, RA-2201
Graybar Elec. Co., Inc.
Jerry Foster, RA 6452
W. M. Smith Elec. Co.
Gene Jackson, Hamilton 8-4606
EL PASO
General Elec. Supply Co.
Joe Caldwell, 3-3407
Graybar Elec. Co., Inc.
H. Chaparro, 3-7561
FT. WORTH
General Elec. Supply Co.
Paul Huntley, ED 2-5385
Graybar Elec. Co., Inc.
Bill Hart, ED 5-4523
HOUSTON
Buffalo Elec. Co.
Chuck, Sonny, or Andy, CA 8-4431
General Elec. Supply Co.
T. W. Haley, SA 3-3121
Graybar Elec. Co., Inc.
Tom Keen, CA 8-4571
Oliver Armature Works
Thurman Tedder, CA 2-9271
LUBBOCK
General Elec. Supply Co.
Allen Pistole, PO 3-8271

DIAL ME FOR MOTORS

More G-E Distributors on Next Page . . .

GENERAL ELECTRIC

"OFF-THE-SHELF" DELIVERY OF G-E MOTORS 5 TO 20 HP

(Continued from preceding page)

MIDLAND
I. W. Hynd Co.
Wesley Adams, MU 4-5501
SAN ANTONIO
San Antonio Machine & Supply Co.
S. V. Patrick, CA 5-1651
General Elec. Supply Co.
J. A. Russell, CA 7-1261
TYLER
General Elec. Supply Co.
R. A. Hamilton, 2-1674
WACO
General Elec. Supply Co.
Henry L. Fleischhauer, 2-1611
WICHITA FALLS
Elec. Motor Co.
Eugene Phillips, 7-7841

UTAH
SALT LAKE CITY
General Elec. Supply Co.
EM 3-3911
Graybar Elec. Co. Inc.
Elgin 9-8771
Refrigeration Distributors Corp.
DA 2-5886

VIRGINIA
RICHMOND
Electrical Equip. Co.
T. L. Campbell, 7-2647
General Elec. Supply Co.
L. V. French, 6-4941
NORFOLK
General Elec. Supply Co.
W. E. Sheppard, MA 2-7183
ROANOKE
General Elec. Supply Co.
J. W. Hughes, 3-1564
Graves-Humphreys Hdw. Co., Inc.
R. W. Eldridge, 3-8011
Graybar Elec. Co., Inc.
W. C. John, 3-3615

WASHINGTON
SEATTLE
General Elec. Supply Co.
H. J. Halvorsen, SE 6400
Graybar Elec. Co., Inc.
J. R. Savage, MU-0123
Shields, Harper & Co.
S. Klinefelter, EL-2674
SPOKANE
General Elec. Supply Co.
L. P. Stephens, KE 0431
Graybar Elec. Co., Inc.
W. C. Sanders, EM 6611
TACOMA
General Elec. Supply Co.
Dean Elton, BR 8454

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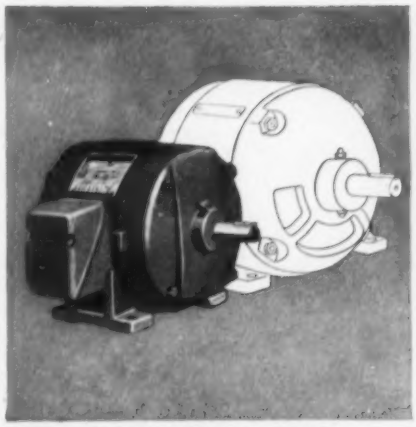
Bluefield Supply Co.
W. E. McDougle, DA 5-6131
CHARLESTON
Virginian Electric, Inc.
W. H. Knight, 6-0631
HUNTINGTON
Virginian Electric, Inc.
L. E. Pauley, 2-8396
LOGAN
Logan Hardware & Supply Co.
J. E. Surndoll, 710
WHEELING
General Elec. Supply Co.
R. L. Nickerson, 2555

WISCONSIN
APPLETON
General Elec. Supply Co.
W. Van Weele, RE 4-7155
GREEN BAY
Graybar Elec. Co., Inc.
K. C. Lynch, HE 7-3284
Beemster Elec. Co.
H. N. Beemster, HE 7-3238
MADISON
Crescent Elec. Supply Co.
C. L. Gilbert, AL 6-5441
Elec. Motor Service
C. Sutherland, AL 6-6724
MILWAUKEE
General Elec. Supply Co.
L. E. (Bud) Tapp, Broadway 6-7730
Graybar Elec. Co., Inc.
R. R. Schober, BR 6-8400
WAUSAU
Snapp Elec. Supply Co.
R. C. Runquist, 2-1031

WYOMING
CASPER
General Elec. Supply Co.
K. R. Brown, 2-7333
CHEYENNE
Frontier Elec. Supply Co.
2-6453

TERRITORY OF HAWAII
HONOLULU
American Factors, Ltd.
Ken Asari, 5-1511

What's Your Motor Problem?

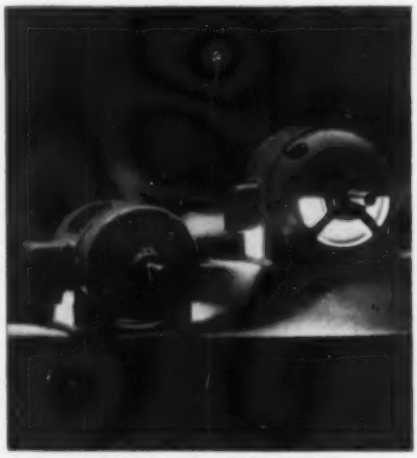


NEED A MORE COMPACT MOTOR? . . .

Excess bulk has been trimmed and all wasted space eliminated from TRI-CLAD '55' Motors. Some are up to one-third more compact!

ONE THAT WATER WON'T FAZE? . . .

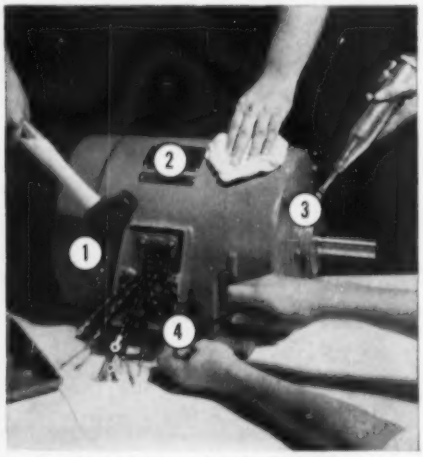
New miracle materials in the TRI-CLAD '55' insulation system make it shed water like a duck's back!



AND 60% GREATER PROTECTION? . . .

New enclosure on the TRI-CLAD* '55' (above) guards it against dirt, dust and moisture *far better* than old-style motors!

*Registered trademark of General Electric Co.



WITH MUCH EASIER MAINTENANCE? . . .

(1) Man-size knock-off lugs, (2) stainless steel nameplate, (3) provision for regreasing on the job, (4) permanently numbered leads.

For more information on the new, fast-service plan—and "special" G-E Tri-Clad motors—call your local G-E motor Distributor.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Motor Shops

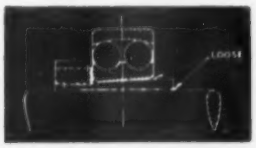
16 Recommended Cures For Noisy Bearings

Bearing noises can be caused by dozens of reasons, each one requiring a different method for correction. Before corrective measures can be taken, however, it becomes necessary to correctly determine the cause behind the audible warning signal. This procedure can be approached logically, for bearing manufacturers have prepared excellent check-lists and guides for intelligently inspecting noisy machines, then eliminating outward symptoms by correcting the internal causes of the trouble. One such list, prepared by SKF Industries, considers many of the more commonly encountered causes. These include:

1) Foreign matter such as dirt, sand or carbon entering the bearing housing. Recommendation is to thoroughly clean out the bearing

housing, replace worn seals, or adopt an improved type of seal design to obtain better bearing protection.

2) Corrosive agents such as water, acids or paint entering the bearing housing. Can be prevented

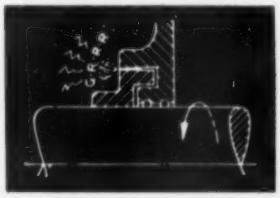


by adding a shroud and (or) a flinger to throw this foreign matter off.

3) Housing bore is out of round or undersized, or housing is warped or excessively distorted. Pinching of bearing can be relieved by scraping the housing bore; also make sure that pedestal surface is flat,

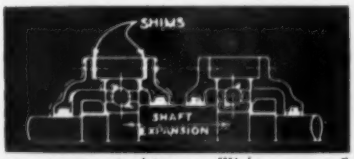
and that shims cover the entire area of the pillow-block base.

4) Adapter tightened excessively. Can be corrected by loosening locknut and sleeve assembly,



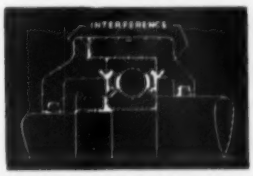
retightening only sufficiently to clamp sleeve on shaft while still permitting bearing to turn freely.

5) Flat spot on roller or ball bearing caused by fast starting and



resultant skidding. This can effectively be cured only by replacing the bearing.

6) Shaft diameter is too small, or adapter is not tightened sufficiently. Suggested correction is to metallize the shaft, regrinding to obtain a proper fit, then retighten



the adapter to obtain a firm grip on the shaft.

7) Bearings were selected with inadequate internal clearance for conditions where external heat is conducted through the shaft, thereby expanding the inner ring excessively. Bearings should be replaced in this instance also, making sure that the replacement bearings have the identical markings of the originals, and checking with the AFBDA (Anti-Friction Bearing Distributors Association) if bearing markings have become indistinct or questionable.

8) Low oil level, loss of lubricant through the seal, or insufficient grease in the housing. Proper oil level should be at the center of the

(Continued on page 144)

Motor Shop Operators In Philadelphia for 23rd Convention

Frank T. Broiles, International Electric Co., Los Angeles, Cal., and Warren W. Sachsenmaier, Keystone Power Plant Equipment Co., Philadelphia, Pa.

Charles E. Johnson, Universal Product Co., Detroit, Mich., C. S. "Pat" Moran, Standard Electric Motor Works, Detroit, Mich., and William Saunders, Lenawee Electric Co., Adrian, Mich. Saunders is a past-director of NISA.

Warren H. Crabb, and Arthur C. Warren, from J & H Electric Company, Providence, R. I.

See "In The News" on page 193.

"Adequate Wiring demands adequate entrance equipment"

NEW-CLARK AMERICAN SERVICE ENTRANCE SWITCH

WITH

- **100 Amp. Main Pullout**
- **4 Branch Pullouts**
- **8 Plug Fuse Branch Circuits**

This five pullout service entrance switch is ideal for the modern all-electric home or the home with more-than-average appliance load. Here in one attractive unit are adequate facilities for practically every combination of range (including the separate range top and built-in oven), water heater, drier, air-conditioner or other 240 volt utilities, plus ample branch circuits for lighting and 120 volt appliances. Sub-feed lugs increase its utility and flexibility. Main pull-out disconnects all circuits. Plenty of knock-outs in top, bottom, sides and back, and extra generous wiring space make installations easy and fast. Write for Bulletin PL 220-2.

American
ELECTRIC SWITCH DIVISION

The **CLARK CONTROLLER** *Company*

1146 East 152nd Street, Cleveland 10, Ohio

lowest ball or roller in the bearing. Or, if grease is being used, half of the pillow-lock should be filled.

9) Using the wrong type of oil or grease can cause a breakdown of the lubricant. Reliable lubricant manufacturer should therefore be consulted to ascertain whether oil or grease is prescribed, and what lubricant charactertistics should be used.

10) Noise may also be caused from a failure to remove chips or dirt from the bearing housing before the bearing unit was assembled. In this case, the housing should be carefully cleaned and fresh lubricant added.

11) Rotating seals are rubbing against stationary parts. Alignment should be corrected, after checking the running clearance of the rotating seal.

12) Opposed mountings. Can be corrected by inserting a gasket between the housing and cover flange, thereby relieving the axial preloading of the bearings.

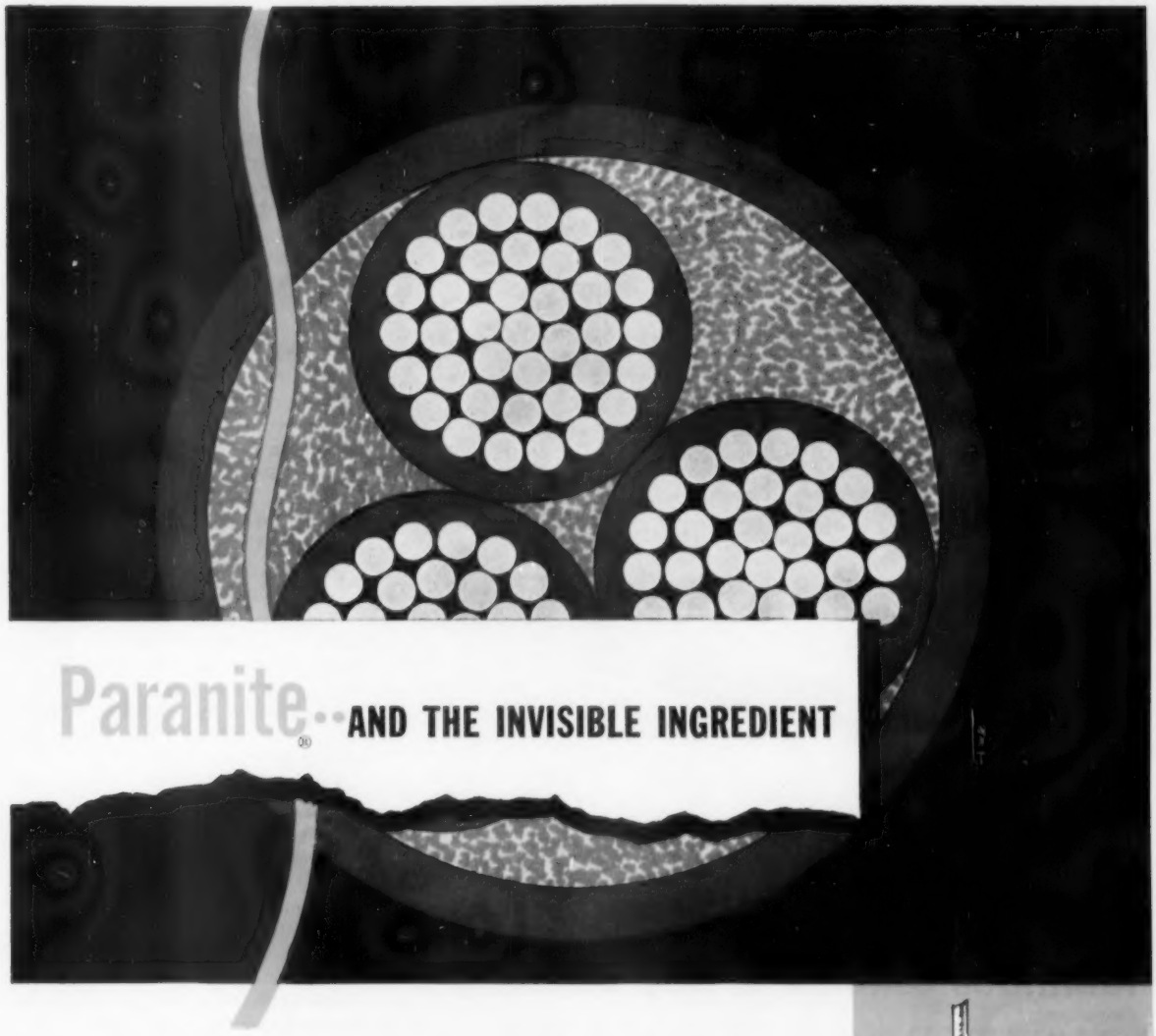
13) Excessive shaft expansion when two bearings are secured or held on a single shaft. This calls for backing off the covers in one of the housings, using shims to obtain adequate clearance of the outer ring, thereby permitting free axial bearing motion.

14) Rubbing of shaft shoulder against bearing seals. Can be corrected by remachining the shaft shoulder to clear the seal.

15) Prong rubs against the bearing. Necessary to remove the lockwasher, straighten the prong, or replace the washer with a new one.

16) Bearing seals are distorted. Again, remachining the housing shoulder is necessary to clear the seal.

ELECTRICIAN Martin Serota, Local 98, got a bird's-eye view of Philadelphia while working atop the towers of the Walt Whitman Bridge that spans the Delaware between Philadelphia and Glouster to further improve traffic conditions.



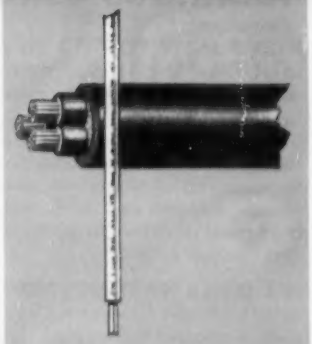
Paranite®--AND THE INVISIBLE INGREDIENT

● Electricians know the various types of wire and cable, of what they are made, and their proper application. But with Paranite products there is an "extra" that you cannot see . . . or feel . . . for Paranite is a perfectionist.

Paradoxically, "good enough" is *not* good enough at Paranite, for since the company was founded 66 years ago, it has been motivated by the desire to make a better product each day than the day before, if humanly possible. This became a habit, then a tradition, and today is the *invisible ingredient.*

Growing aware of the excellence of product that this "invisible ingredient" made possible, wholesalers and contractors coined a phrase decades ago expressing their confidence in Paranite: "If It's Paranite, It's Right." In the course of time, the company adopted this trade phrase as its slogan.

True in past years—more true today! The "invisible ingredient" still silently assures you that every foot of Paranite Wire and Cable is as nearly perfect as human hands can make it . . . utilizing modern equipment and cautious testing.



From POWER CABLE to FIXTURE WIRE . . . you'll find Paranite quality high . . . service outstanding!

PARANITE WIRE AND CABLE

DIVISION ESSEX WIRE CORPORATION

FORT WAYNE 6, INDIANA

MANUFACTURING PLANTS: **Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.**

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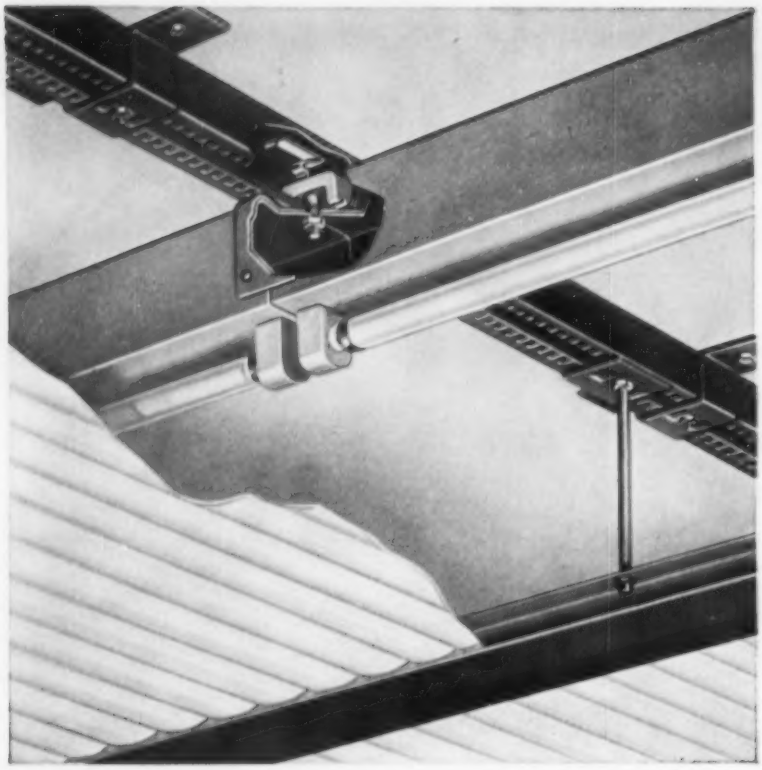
*Atlanta, Georgia; Boston, Massachusetts; *Chicago, Illinois; Cleveland, Ohio; Dallas, Texas; *Detroit, Michigan; Hartford, Connecticut; Indianapolis, Indiana; *Kansas City, Missouri; *Los Angeles, California; *Newark, New Jersey; Omaha, Nebraska; *Portland, Oregon; Upper Darby (Philadelphia), Pennsylvania; Rochester, New York; *Saint Louis, Missouri; *San Francisco, California; Seattle, Washington; Springfield, Illinois.



Mult-A-Frame It!

The quick and easy way to install luminous ceilings in any building

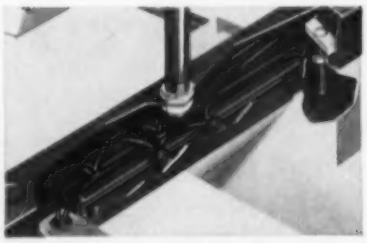
HERE'S HOW YOU DO IT: attach MULT-A-FRAME directly to present ceiling with standard suspension brackets. T-bolt-clamp fluorescent fixture to channel. Drop hanger rods from same channel. Drill through top of aluminum track and attach hanger rod with standard hexagonal nut. Lay in plastic ceiling and the job is done.

IT'S QUICK, EASY, ECONOMICAL: only tools required are a saw, drill and wrench. No skilled labor is needed and installation takes less time than with special materials. The result: a double saving—in man hours and cost per hour.

See our catalog in SWEET'S

E-3

LIKE TO KNOW MORE: simply write today for your free copy of the complete MULT-A-FRAME story told in the illustrated brochure, "Hold Everything." You can actually install a luminous ceiling at lower cost than a conventional one.



Use MULT-A-FRAME as a raceway. Closure strips and end caps are available that snap into position at the pressure of your fingers.

MULT-A-FRAME

MULT-A-FRAME DIVISION

Ainsworth Manufacturing Corporation

1471 E. Atwater St., Detroit 7, Mich.

SHIFT TO 480 VOLTS, 3-PHASE TRIPLES CAPACITY

[CONTINUED FROM PAGE 107]

on a free-standing rack and connected temporarily to the old vault service.

When the time came for actual changeover of risers, it took an average of only 2½ hours per feeder, including all tenant and transformer connections at the various floors.

Conversion to 480-volt, 3-phase distribution is being heralded as one answer to economical upgrading of wiring systems in many of Chicago's 100,000 apartment buildings housing five or more families and constructed prior to 1935. The 5000 East End Avenue project proves it is feasible.

At present, the Commonwealth Edison Company is developing plans to make 480-volt, 3-phase conversion available to smaller buildings. To be economical both to the utility and owner, the Edison Company believes a building should possess the following physical characteristics:

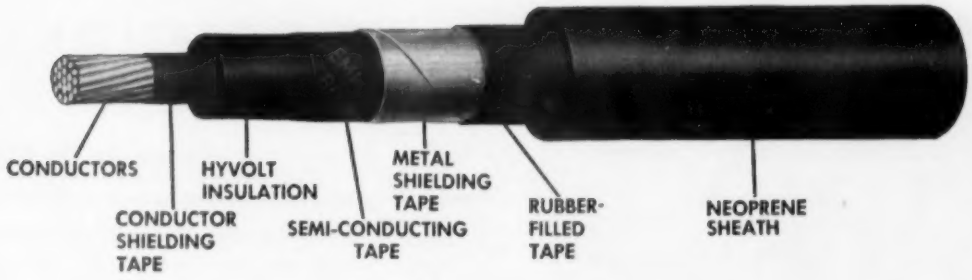
1. An electrical demand to exceed 100 kilowatts.
2. A height of ten or more stories, or a width and length covering a large area.
3. Construction which renders installation of additional or larger conduits difficult.
4. Building located so there is a suitable place for a rack, platform or vault for 480-volt, 3-phase distribution transformers.
5. A suitable place in the building for a 480-volt service accessible only to authorized personnel.
6. An existing riser system with a sufficient capacity, when converted to 480 volts, to take the anticipated load.
7. A suitable, well ventilated, accessible, safe place to install dry-type, 4 to 1 transformers for 120/240-volt tenant service.
8. A wiring system arrangement which can be connected to both 480 and 120 volts.

Buildings meeting these conditions provide a natural market for conversion. Surveys of others needing and wanting a system of this type can easily determine the economics of the transition. The method is available and waiting to give kilowatt-starved apartment buildings a new lease on electrical living.

CRESCENT

OVER 70 YEARS EXPERIENCE

HYVOLT SHIELDED POWER CABLE



For More Amperes Per Dollar of Installed Cost

ADVANTAGES

1. Long life
2. Can be operated at 85°C. Permits smaller conductors or more amperes per conductor.
3. Freedom from corona cutting
4. Excellent resistance to moisture
5. Low power factor and dielectric loss
6. Lighter, more flexible, easier to handle and install than lead covered cables
7. Electrolytic or chemical corrosion of lead sheath is eliminated by use of neoprene sheath
8. Shielding prevents possibility of surface burning and provides safety to human life.

CRESCENT HYVOLT insulation is made from butyl rubber which is inherently resistant to ozone, heat, moisture and aging. HYVOLT is formulated and processed so as to retain these inherent characteristics of the butyl rubber and at the same time provide excellent electrical and physical properties.

The insulation is protected during and after installation by an outer neoprene sheath providing a maximum degree of toughness, durability and long life. It is flame retarding and resistant to the deteriorating effects of moisture, sunlight, ozone (corona), oil, grease, and many acids and alkalies.

HYVOLT Shielding provides additional internal and external protection in these THREE WAYS

1. Conductor shielding, as provided by a semi-conducting tape over the stranded conductors, excludes air pockets between conductor and insulation and eliminates possible internal corona-cutting of the insulation.
2. The semi-conducting tape between the insulation and metallic shielding tape prevents possible ionization of air spaces and corona at the insulation surface.
3. The metallic shielding tape is grounded when installed, resulting in zero potential to ground at the sheath. It prevents surface discharge or burning, and protects cable from lightning surges. Reduces shock hazard.

RECOMMENDATIONS

CRESCENT SHIELDED HYVOLT CABLE is recommeded for use in conduits, underground ducts, in wet or dry locations, or buried directly in the ground, for circuits operated at over 3000 volts and in accordance with I.P.C.E.A. recommendations. Available in single conductor or multi-conductor cables.

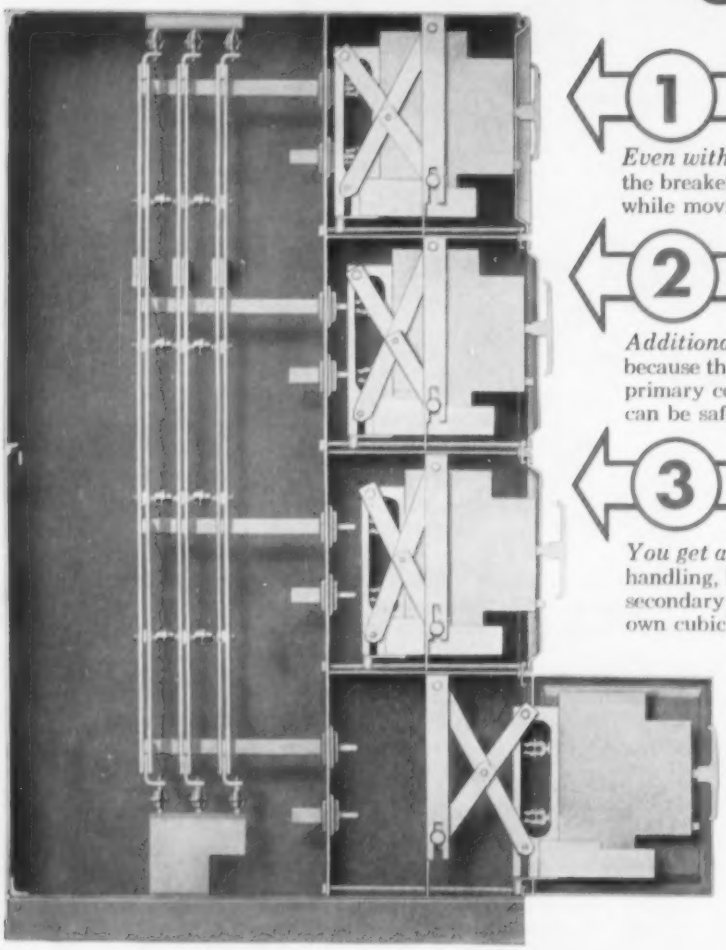
Specify CRESCENT SHIELDED HYVOLT POWER CABLE for general power circuits and where severe conditions are prevalent such as chemical plants, refineries, paper mills, mines, sewage disposal plants, etc. It is approved as Airport Lighting Cable Type B, CAA Specification L-824.

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON 5, N. J.

Positive Protection for YOUR Personnel

Get the Low Voltage Switchgear that's Fully Enclosed in ALL 3 POSITIONS



1 OPERATING POSITION

Even with the door open, dead-front construction of the breaker means complete safety for your personnel while moving breaker in or out of operating position.

2 TEST POSITION

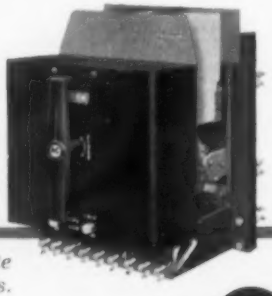
Additional protection for your personnel is assured because the breaker can be moved to test position with primary contacts disconnected, and breaker operation can be safely checked with compartment door closed.

3 DISCONNECTED POSITION

You get added convenience — save storage space and handling, because the breaker, with both primary and secondary contacts disconnected, can be stored in its own cubicle with the door closed.

Inspection also is simplified. In the fully withdrawn position the primary and secondary contacts are clearly visible for inspection without removing the breaker from the cubicle — and it's all done with a convenient, reversible door panel and a rigid, positive-positioning pantograph mechanism.

The breaker provides new flexibility. Long time, short time and instantaneous tripping devices are available. Each is adjustable independently of the other. Selective trip feature available initially or may be added later. Time delay device is sealed, positive displacement type for accuracy. An unusual feature of this new breaker is the faulted phase indicator which tells your operator at a glance on which phase fault occurred. Breaker is dead-front for safety of personnel.



Get more information. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

A-5055

ALLIS-CHALMERS

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  Use second line of boxes. Insert item numbers of literature desired.

- **ADVERTISEMENTS:**

  Use third line of boxes. Insert page numbers of advertisements on which additional information is desired. Where more than one advertisement appears on the page, include the manufacturer's initials.

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Circuit Breaker (2)

A new Type TQL, 2-pole, switching neutral circuit breaker designed to meet safety requirements in gasoline station dispensing pump circuits. It is UL listed. It is a plug-in design that fits all G-E load centers. The switching neutral feature permits circuit protection in compliance with NEC Article 510, Section 5120e, which states that disconnects for gasoline station dispensing pump circuits shall be able to disconnect all conductors of the circuit from the source of supply. One pole, with line and load ter-

Floodlight (4)

Series 4000 minimum-enclosed floodlights now available to meet NEMA Specification FL-6-210 for general purpose floodlights, 300 to 1500 watts. Specular and diffuse Anodal finished reflectors provide NEMA Types 2, 3, 4, and 5 beam spreads, each equipped with thermal shock and impact-resistant lens, stainless steel lens ring, beam sight, built-on wrench, repositioning stop, and watertight connector. Also available for bi-post and 400-watt mercury vapor lamps. Complete catalog data available.

Steber Mfg. Co., Broadview, Ill.

Duplex Outlet (6)

A weatherproof duplex outlet, complete with mounting box. Cover and plate gaskets as well as a rubber grommet are furnished with the device to seal the entire installation against the weather. Positive latching aluminum alloy caps seal the unit when it is not in use. The box is of cast aluminum. Entire installation is especially treated to withstand severe weather conditions such as the U. S. Navy salt water spray tests. A provision is made in the box for a third wire ground wherever it is necessary. Unit is rated at 15 amps, 125 volts.

Pass & Seymour, Inc., Syracuse, N. Y.

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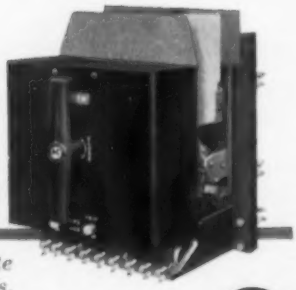


Get more information. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

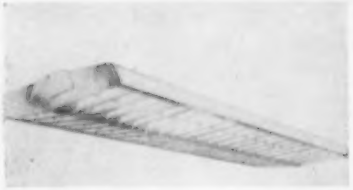
A-C ALLIS-CHALMERS

A-5055

ALLIS-CHALMERS

LIVE BETTER ELECTRICALLY

Product News



Luminaire (1)

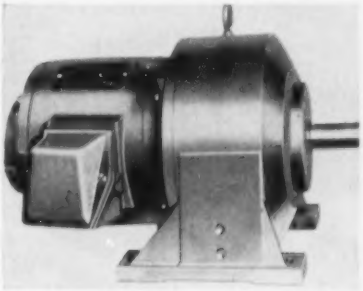
New L1680 series fluorescent fixture designed for school lighting is adaptable for any commercial or institutional interior where the seeing task is critical. The all-white Visionaire has metal louvers providing 35-degree shielding in both directions and translucent, ribbed, plastic side panels, metal-reinforced for rigidity. Ample knockouts along top of channel permit quick installation for either pendant or ceiling mounting. Maintenance features include spring release catches which allow cover and louver to be lowered as a single unit and to remain suspended on jack chains. All metal parts are Bonderized for permanent corrosion resistance and finished in durable baked white enamel.

Sunbeam Lighting Co., 777 E. 14th Pl., Los Angeles 21, Calif.

Circuit Breaker (2)

A new Type TQL, 2-pole, switching neutral circuit breaker designed to meet safety requirements in gasoline station dispensing pump circuits. It is UL listed. It is a plug-in design that fits all G-E load centers. The switching neutral feature permits circuit protection in compliance with NEC Article 510, Section 5120e, which states that disconnects for gasoline station dispensing pump circuits shall be able to disconnect all conductors of the circuit from the source of supply. One pole, with line and load terminals, contains thermal and independent magnetic trip elements for automatic short circuit and overload protection. The other pole provides a separate terminal (electrically isolated from the main bus) for connecting the incoming neutral wire to a nonautomatic switching mechanism. A wired-in lead completes the circuit to the load center neutral assembly. Breaker is available in continuous current ratings of 15 and 20 amps, 120 volts ac. Its interrupting rating is 5,000 amps ac.

General Electric Company, Trumbull Components Department, Plainville, Conn.



Gearmotors (3)

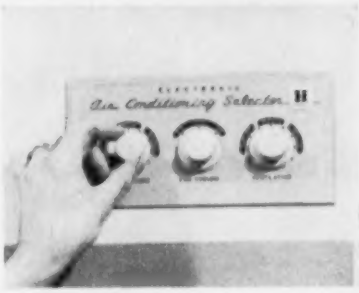
New line of gearmotors now available in both ac and dc from 1 through 60 hp. They are designed and built to give trouble-free performance under adverse operating conditions. Two-way seals lock oil in and seal dirt out so that the gearmotors may be mounted in any position without oil leakage. Induction hardening provides hard tooth surfaces on steel gears. A wide selection of mountings, enclosures, and ratios affords custom gearmotors for all applications.

Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio.

Floodlight (4)

Series 4000 minimum-enclosed floodlights now available to meet NEMA Specification FL-6-210 for general purpose floodlights, 330 to 1500 watts. Specular and diffuse Anodal finished reflectors provide NEMA Types 2, 3, 4, and 5 beam spreads, each equipped with thermal shock and impact-resistant lens, stainless steel lens ring, beam sight, built-on wrench, repositioning stop, and watertight connector. Also available for bi-post and 400-watt mercury vapor lamps. Complete catalog data available.

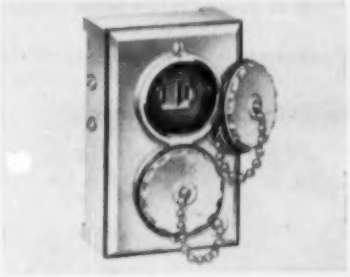
Steber Mfg. Co., Broadview, Ill.



Selector Panel (5)

A new electronic air conditioning selector panel developed for offices, small department stores, drug stores or super-markets. Designed for installation in the manager's office, it lets him control customer comfort from his own desk. Designed for flush-mounting on a wall within arm's reach of the desk, the robins-egg blue Plexiglass panel contains dials that give fingertip electronic control over the temperature in the store, permits raising or lowering of the amount of outdoor air for ventilation, and provides for manual or automatic fan operation or fan shut-off. Control panel may also be provided in a locked box to prevent tampering. Literature is available.

Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.



Duplex Outlet (6)

A weatherproof duplex outlet, complete with mounting box. Cover and plate gaskets as well as a rubber grommet are furnished with the device to seal the entire installation against the weather. Positive latching aluminum alloy caps seal the unit when it is not in use. The box is of cast aluminum. Entire installation is especially treated to withstand severe weather conditions such as the U. S. Navy salt water spray tests. A provision is made in the box for a third wire ground wherever it is necessary. Unit is rated at 15 amps, 125 volts.

Pass & Seymour, Inc., Syracuse, N. Y.

- *Multiple locking edges for greater bond. Assures positive ground for electrical system.*
- *Spring tension against locking surface provides permanent shake-proof installation.*
- *Reverse bevel on inner surface permits bonding edges to be pulled up tight to locking surface.*
- *Up to 66% more driving notches for easier working angle, when tightening.*
- *Heavy gauge steel. Cadmium plated for corrosion protection.*

COMPARE THESE midwest LOCKNUT FEATURES...

These "Sure Bond" Locknuts are specifically designed to do a better job. Compare these features against those of other types of locknuts. All Midwest fittings, 2" and smaller, come equipped with "Sure Bond" locknuts.

★ Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

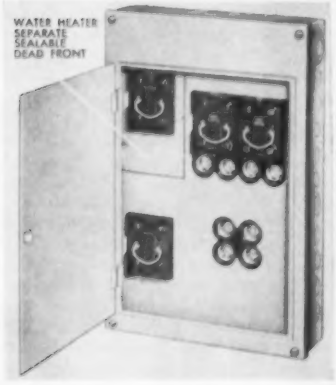
1639 W. WALNUT STREET

Chicago 12, Illinois

Electric Heater (7)

A new, built-in-wall, fan driven electric heater, 20 in. high by 14 in. wide. Four wattage outputs are available, 1500, 2000, 3000 and 4000 watts, for operation on 230-240 volts ac. The front cover extends 1½-in. into the room. Heaters may be flush mounted at any location in the room, fitting between standard 16-in. wall stud spacing. The metal-sheathed, finned heating elements are moisture-proof, sagproof, and shockproof. Low-speed fan draws cool air from floor and gives it a low velocity push over the heating element and through the top finned covering opening. Heater has a built-in adjustable thermostat to automatically maintain any temperature selected between 55 and 85° F. A separate on-off switch operates heater without disturbing the comfort-level setting of the thermostat. Bulletin No. 955 is available.

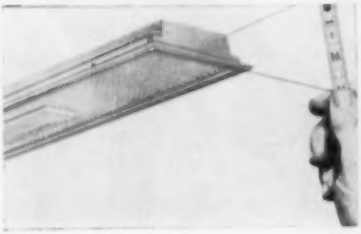
Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh 8, Pa.



Switch (8)

New 100-amp main lugs was designed to adequately protect and control, by means of fusible "Renu-Fuse" pullcover construction, water heater, range, dryer, lights and applications. In addition, it has 8 or 12 plug fuses (single fused) circuits for lights, appliances, etc. The water heater "Renu-Fuse" pullcover assembly has its own separate compartment with a removable end partition, and separate sealable deadfront. Water heater unit may be fed by the general service meter or it may be metered separately. It is a 3-pole solid neutral, 120-240 volts ac switch with 60-amp "Renu-Fuse" pullcovers for range and lighting unit controls and 30-amp for the water heater and dryer or 60-amp when specified. Available in both surface and flush mounting.

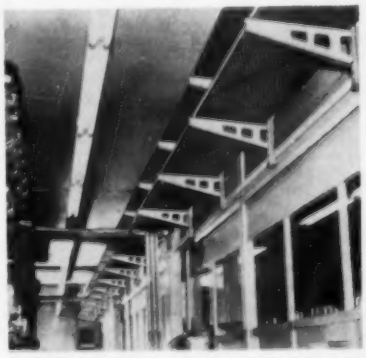
Wadsworth Electric Mfg. Co., Inc., Covington, Ky.



Troffer (9)

A new line of three "Thin-Lite Troffers", requiring only 2¾-in. above the ceiling line. They are designed to save space for air-conditioning ducts, piping, etc. The series offers three types of shielding and diffusing media. The one-piece polystyrene louver panel has cells that are ⅝-in. by ⅝-in. by ⅞-in. and the shielding is 42 degrees by 42 degrees. The second utilizes the Corning No. 70 low brightness flat glass lens. The third is a formed acrylic diffuser ¼-in. thick. The diffusers are framed and hinged, and are removable from the fixture without the use of tools, for servicing. All models are 48 in. in length and each is equipped with two 430 ma rapid-start 4-ft lamps.

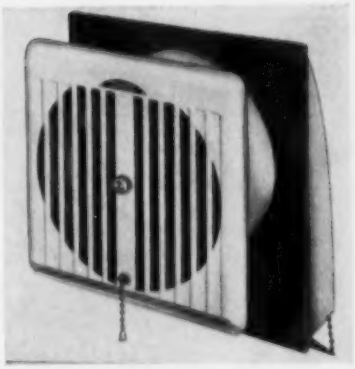
Lighting Products, Inc., Highland Park, Ill.



Support for Cable Trough (10)

A new Rakit cantilver-type support has been designed by Cope for its expanded metal cable trough supporting systems. A twist of the wrist is all that is necessary to secure the Rakit arms to which the trough is bolted. The arms are secured to upright channel irons with pre-punched holes that provide a wide number of possible settings.

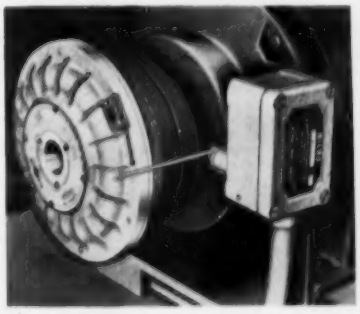
T. J. Cope, Inc., Collegeville, Pa.



Kitchen Ventilator (11)

A new builders' special line of kitchen ventilators. The outside doors are the positive-action type, and cushion sealed for airtightness. On Models 952 and 953, doors and motors are switch started. On 950 and 951, they are actuated by pull chain which is pre-installed on units before delivery. Housings are nailed to outside sheathing, and tube assemblies are inserted in hole. The wire is pulled into the box and connected to the pre-wired cover assembly. Unit's motor snaps into place and is held rigid without mounting screws.

Fasco Industries, Inc., Rochester 2, N. Y.



Thermal Cutout (12)

Protection against overheating of Flexidyne, the dry fluid drive, is provided by a thermal cutout. Instantaneous mechanical overload protection is inherent in the Flexidyne. If an overload causes prolonged slipping and consequent heating of the Flexidyne, the thermal cutout trips the switch, cutting off power and, if desired, giving an alarm. It is recommended especially for all unattended installations. Device mounts on the side of the Flexidyne. It contains a trigger spring, held down by an alloy thermal pin. Before the Flexidyne can heat up enough to cause any damage, the thermal pin will melt, allowing the trigger to spring out so that it will push the non-sparking striker of the special switch to the "off" position.

Dodge Manufacturing Corp., Mishawaka, Ind.

SIMPLEST, SAFEST

IDEAL

CRIMP CONNECTORS

with the "Wrap-Cap"*

THE UNIQUE DIAPER-WRAP INSULATOR

UL ONLY 2 PARTS

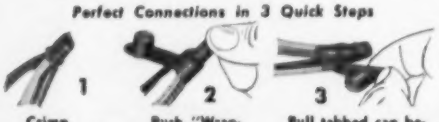
Both the cadmium plated steel sleeve and the "Wrap-Cap" Insulator are listed by Underwriters Laboratories, Inc. for general use, (600 V) in branch circuit and fixture wiring.

*Patented, No. RE23649 and other patents pending.

Anyone who can use a pliers can make a perfect wire joint every time with the IDEAL Crimp Connector! The whole operation takes just seconds!

Stronger, better insulated and easier to use, IDEAL Crimp Connectors give you perfect, pre-fabricated insulation all around the joint and between the wires, with a puncture-proof cap and *double thickness* over the wire ends, *plus* a deep skirt that completely covers the bare conductor even when wires are not stripped evenly.

Perfect Connections in 3 Quick Steps



1 Crimp sleeve with IDEAL Electricians pliers.

2 Push "Wrap-Cap" down over sleeve.

3 Pull tabbed cap between wires and over end of joint.

NO EXTRA TOOL NEEDED!

IDEAL All-Purpose ELECTRICIANS PLIERS

Crimp the Sleeve, Twist the Wire Burr the Conduit

A tool so good you'd want it even without the IDEAL Crimp Connector! Built for all around electrical use. Plastic covering on handles give comfortable grip.

(Patent Pending)

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS
In Canada: Irving Smith, Ltd., Montreal

IDEAL

IDEAL INDUSTRIES, INC.
1041 Park Avenue, Sycamore, Illinois

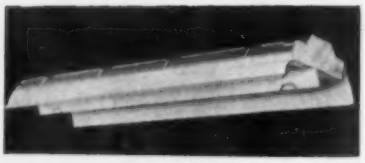
Please send catalog data on the new IDEAL Crimp Connector, "Wrap-Cap" Insulator and Electricians Pliers.

Name_____

Company_____

Address_____

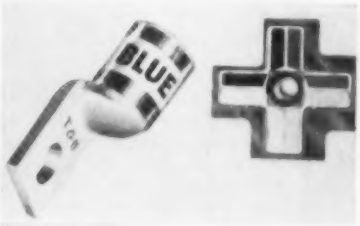
City_____ Zone____ State_____



Fluorescent Fixtures (13)

The new semi-direct Imperial provides approximately 25% upward light, 30-degree shielding crosswise, is available in 2-lamp 48- and 96-in. rapid-start, slimline and 800-ma rapid-start lamps, and features rigid 4-ft porcelain-enameled reflector sections with extruded apertures. The direct-lighting Crown provides approximately 10% upward light and is available in 2- and 3-lamp 48- and 96-in. rapid-start and slimline, 2-lamp 48- and 96-in. 800 ma rapid-start, and 2-lamp 60-in. T-17 general line. Also available without apertures where upward lighting is not required.

The Miller Company, Meriden, Conn.



Connectors (14)

A new line of compression connectors for code copper conductors, featuring faster installation through color coding and hand tooling. The new line consists of one- and two-hole lugs and 2-way connectors from No. 8 AWG to 1000 MCM. Each connector size from No. 8 AWG to 250 MCM is color coded to correspond to a die in the hand tool. Correct selection of a connector and its die for a particular installation is achieved by matching the color. The hand tool, TBM 5, assures a perfect joint of high pull-out values and low resistance between the fitting and conductor. Copper connectors are tinplated. They are drilled to NEMA standards, and have been approved by UL.

Thomas & Betts Co., 36 Butler St., Elizabeth, N. J.

Lamp Guards (15)

This line of rubber-hook lamp guards is now available with the new thumb-release clamp cage, which permits changing burnt-out bulbs without tools. Rubber-hook handle is made of hard molded rubber encasing a steel core. Handle is vulcanized to a pliable molded rubber socket portion. Cord wires are run through a fiber

disk supported in a cavity and knotted, to take all strain off the cord and socket connection. Available in several styles. Model 652, for use with 60 to 100-watt bulbs, features an open cage. Model 652-R cage has a built-in reflector. Model 652-S is equipped with a Levolier switch. Model 652-SR has both reflector cage and Levolier switch. This series is available with mill-type cages to accommodate 50-watt rough service bulbs designated as Models 652-M, 652-MR, 652-MS, and 652-MSR. Both 652 and 652-M series are available also with a watertight socket.

McGill Manufacturing Co., Inc., Valparaiso, Ind.

Wiring System (16)

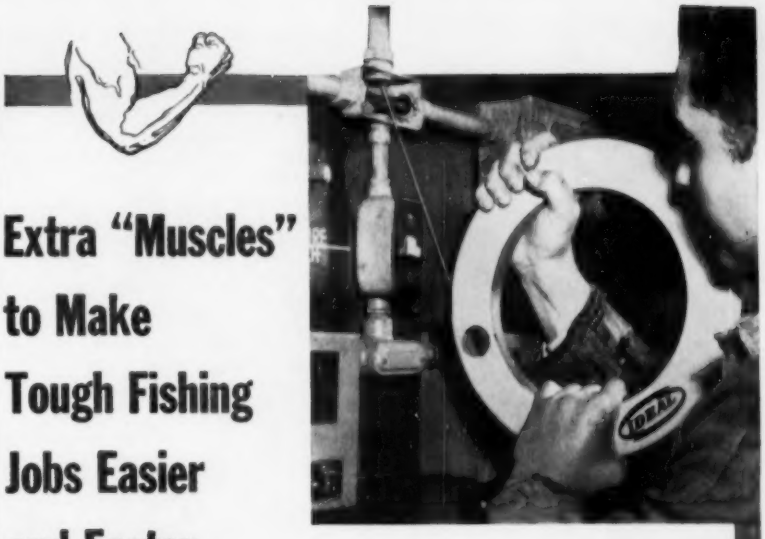
Plugmold 2200, a combination multi-outlet and electrical wiring system and steel baseboard. Originally designed for use in prefabricated homes where it can serve as the complete, all-inclusive wiring system, packaged and ready to install on the spot in minimum time, Plugmold 2200 replaces regular baseboards and has extra capacity to carry additional wiring for future expansion. It is dimensionally correct, making it possible to extend with wood base wherever the Plugmold system is terminated. Baseboard is 2¾-in. wide with outlets located 30-in. or 60-in. on centers. It opens a new field of application in surface wiring and is a "natural" for all new home construction. In addition, it will find wide use in commercial and industrial wiring since it is designed to carry up to 10 No. 12 conductors. It is listed by UL.

The Wiremold Company, Hartford 10, Conn.

Terminal and Conduit Boxes (17)

A new line of terminal and conduit boxes for electric motors. Boxes are of drawn steel, and are available in four sizes; No. 1 will take conduits from ½-in. to 1-in.; No. 2 will take 1-in. and 1¼-in. conduit; No. 3 will take 2-in. and 2½-in.; and No. 4 will take up to 3-in. conduit. Gaskets for use between back of box and motor and between box and cover are also available. These boxes are also suitable for use on transformers and other machines where leads must be connected.

Kolton Electric Mfg. Co., 123 New Jersey Railroad Ave., Newark 5, N. J.



Extra "Muscles" to Make Tough Fishing Jobs Easier and Faster

IDEAL

FISH TAPE, REEL and PULLER

Standby of electricians for close to a generation, IDEAL Fish Tape, Reels and Pullers can help you do any wiring job faster and easier. They're like an extra arm or bigger muscles—make pulling easier and safer. The reel gives you the leverage you need — and keeps the tape always in the reel or conduit. The tape can't spring loose into moving machinery or "hot" lines.

You reel in and pull the tape through conduit in one easy operation . . . no skinned fingers —no cuts—and no lost time! The tape never gets snarled.

Saves work—saves time—saves money! The IDEAL Fish Tape Reel and Puller costs so little you can't afford to be without it! 50 to 200 foot lengths—all tapes are of finest grade, oil tempered flat spring steel.

Now Step Up the Performance of Your IDEAL Fish Tape, Reel and Puller with the

NEW IDEAL FISH TAPE WINDER

Makes IDEAL Fish Tape Reel Even More Useful

Reduces still further the work of fish tape pulling when used with an IDEAL Fish Tape Reel. As Winder is pulled around Reel it spreads the Reel housing so that the tape can be reeled in or out with least effort. Double rollers hold Winder in place as handle is rotated. Three sizes for all IDEAL Reels.

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS
In Canada: Irving Smith, Ltd., Montreal

IDEAL INDUSTRIES, INC.
1041 Park Ave., Sycamore, Ill.
Please send catalog data on IDEAL Fish Tapes, Reels and Pullers and Fish Tape Winders.

Name_____
Address_____
Company_____
City_____ Zone____ State_____

IDEAL

Ask these questions, too, when you judge a fluorescent lamp...

Is it made with Halo Phosphor?

No other phosphors in use today can match Halo Phosphors for maintaining high light output and original color. Westinghouse (and only Westinghouse) uses Halo Phosphors throughout its entire fluorescent lamp line.

Are its electrodes built for longest lamp-life?

Constant development of new and better ways to make fluorescent lamp electrodes has enabled Westinghouse to *triple* the life of its fluorescent lamps since 1948.

Is it easy to seat securely?

Westinghouse fluorescent lamps are built with "guide bumps" on the end-caps. Easily felt with the fingers during lamp installation, they tell at a touch when the lamp has been securely seated in its sockets.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp representative. You can be sure . . . if it's Westinghouse.

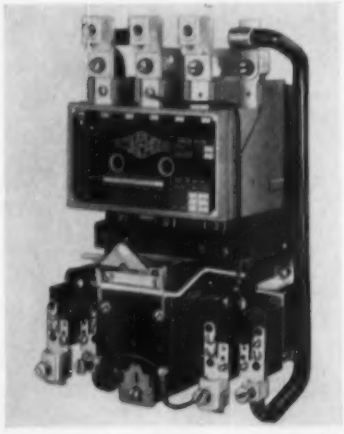
WATCH WESTINGHOUSE

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

Fire Alarm (18)

An approved manual fire alarm system, designed particularly for high schools, offices, factories and other large buildings, indicates the location of the fire and effects immediate evacuation of occupants. Typical warning devices used include 4-, 6- or 10-in. bells and flush-mounted or grille-type horns. Warning devices and alarm stations are wired through a closed circuit to a supervisory control panel consisting of supervisory relays, terminals, fuses, trouble bell and milliammeter. Listed by Underwriters' Laboratories.

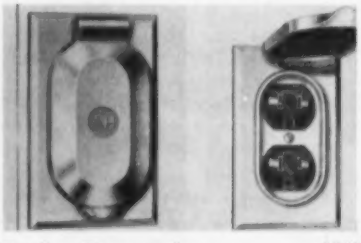
Edwards Co., Inc., Norwalk, Conn.



Motor Starter (19)

A new size 4 electric motor starter, rated 50 hp, 220 volts and 100 hp. 440 volts. It offers three basic design advantages—(1) compact, slightly larger than size 3; (2) standardized design—non-current carrying elements such as magnet assembly, arc box, cross arm, mounting plate and like are interchangeable with size 3; (3) dual purpose—reconnectable dual voltage coils. Bulletin 5604 is available.

Furnas Electric Co., 1067 McKee St., Batavia, Ill.



Duplex Receptacles (20)

A new line of flush duplex weatherproof receptacles accommodate any two standard plug caps. Weatherproof assembly is available with a wide range of duplex receptacles—up to 20 different types. Unit is available side-wired, back-wired, and side-wired, 2-wire or 3-wire. Suitable for use wherever installation exposes receptacles to weather, moisture, acid fumes. Features are: cast aluminum plate, spring lift-lid cover with rubber gasket that seals cover when closed, and rubber mat on underside of plate that makes a weatherproof seal between box opening and building wall.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Fluorescent Units (21)

New Sky-Liter fluorescent lighting units designed for surface mounting or recessed installation measure 2x2 ft, 2x4 ft, and 2x8 ft; utilize 24-in., 20-watt trigger-start, 48-in. rapid-start, or 96-in. slimline lamps; and may be installed individually, in tandem, parallel, or at right angles to achieve any geometric design. Rattan and Crystal panels come in Vinylite; Saxon unit uses Plexiglass. All units have drop-bar between panels to facilitate quick removal for cleaning and lamp replacement. Ballast equipment is easily accessible for servicing without removing the lamps.

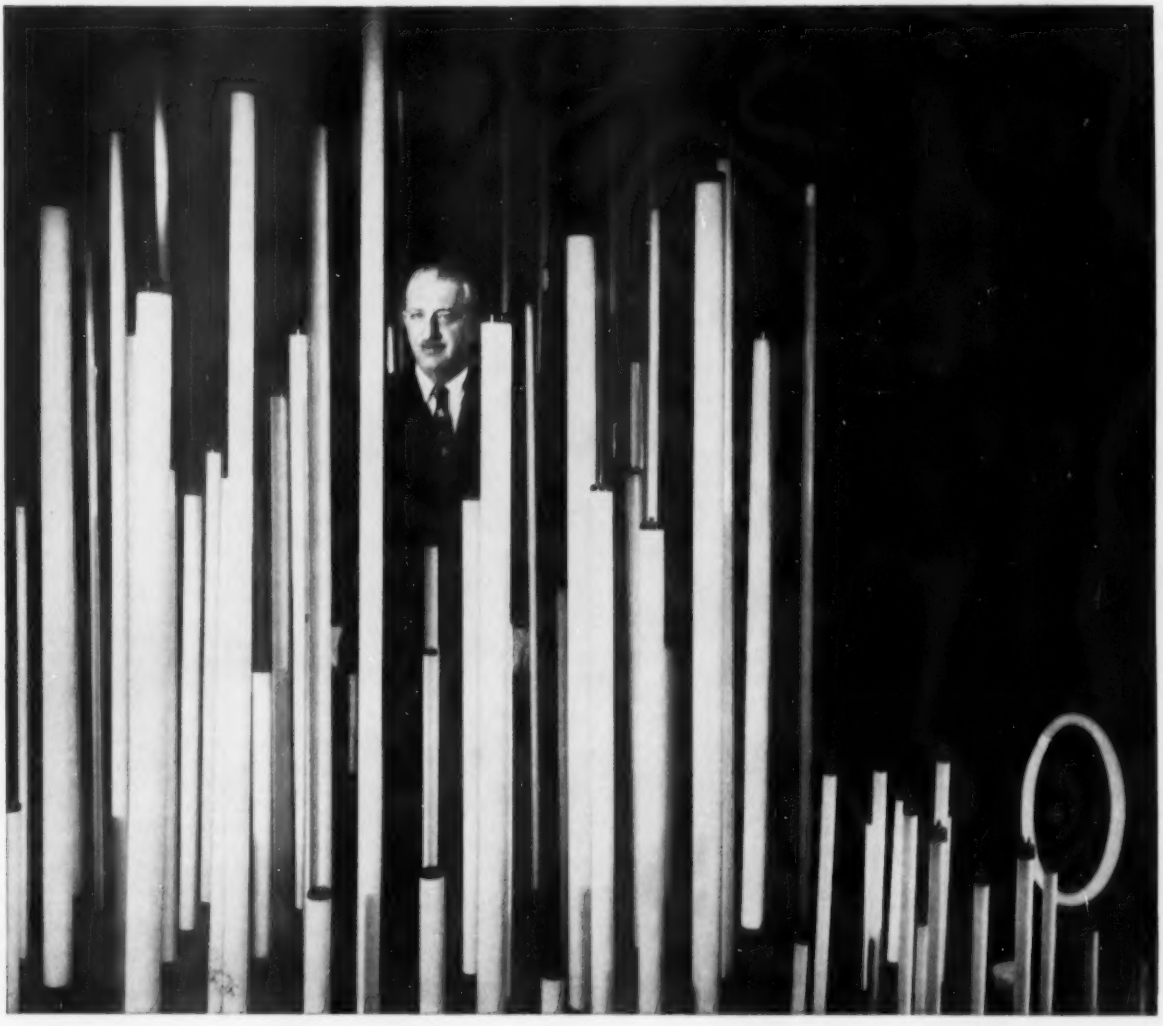
Benjamin Electric Mfg. Co., Northwest Highway and Seegers Rd., Des Plaines, Ill.

Winding Thermostat (22)

The C4344-28 motor winding thermostat is a tiny, snap-acting disc-type, hermetically sealed thermostat designed to be attached directly to the end-turns of large integral hp motor windings prior to impregnation and baking. It is used to interrupt the magnetic starter in cases where the temperature build up in windings is not recognized by the remotely located overload relay. Thermostat provides full running protection under all conditions of overheating in which the temperature rise is gradual. It will withstand vacuum impregnating and baking at a maximum temperature of 500°F. and is sealed with insulation for 600 volts. Technical bulletin is available.

Metals & Controls Corp., Spencer Thermostat Div., Attleboro, Mass.

how to judge a fluorescent lamp . . . point no. 4



ask about **FULL SELECTION**

Smartest move you can make when you buy fluorescent lamps is to see to it that you get precisely the right type, size and color for the lighting job to be done. In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. And the full Westinghouse color range includes seven different shades of "white" alone. You can be sure . . . if it's Westinghouse.

WATCH WESTINGHOUSE

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

NEW

ARROW AH HART

DUPLEX

Weatherproof

GROUNDING

RECEPTACLES

5262WP

OPENED

CLOSED

Listed as Standard by Underwriters' Laboratories

ALSO *20* DIFFERENT

OTHER DUPLEX RECEPTACLES

When installation will expose receptacles to weather, moisture, acid fumes, etc., Arrow-Hart's new line of quality duplex receptacles will fill the need . . . up to 20 types complete with unique weatherproof plates. Plate is cast aluminum with a spring lift-lid cover. A rubber gasket seals the cover when closed; a rubber mat under plate makes a weatherproof seal between box opening and building wall. Write for Catalog Data.

HART-LOCK INTERLOCKING TYPE

XT-7580-WP

COMBINATION DUPLEX GROUNDING TYPE

5290-WP

XT-7540 WP

SPECIFICATION GRADE, TWO-WIRE TYPE

1913-WP

400-WP

ARROW AH HART

Wiring Device Division

THE ARROW-HART & HEGEMAN ELECTRIC CO.

103 Hawthorn Street, Hartford 6, Connecticut

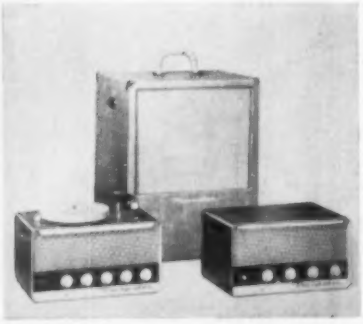
Offices, Sales Engineers and Warehouses in Principal Cities

Quality WIRING DEVICES • MOTOR CONTROLS • ENCLOSED SWITCHES • APPLIANCE SWITCHES

Current Transformer (23)

A 15000-volt indoor current transformer for switchgear application. Available in all standard ASA current ratings from 15:5 to 800:5 amps the new JKS-5 replaces the present JS-1 asphalt-insulated design. Frequency of transformer is 25/60 cycles and thermal rating is 100% of rated current with 55C ambient and 133% of rated current with 30C ambient. Unit uses molded butyl as both insulation and case.

General Electric Company, Schenectady 5, N. Y.



Amplifiers (24)

New line of commercial amplifiers and accessories includes amplifiers rated at 10, 20 and 33 watts ac; two 6-volt 20-watt mobile amplifiers, one with single-speed and one with 3-speed phono top; two 12-volt 20-watt mobile amplifiers, same speed combinations; a 10-watt system including a 10-watt amplifier and speaker; and an individually available 3-speed phono top and a systems case. This Pacemaker line features illuminated dial panels on all models, recessed carrying handles, scratch-resistant surface and effective feedback control. Two speaker outputs are provided on all models.

Bell Sound Systems, Inc., 555 *Marion Rd., Columbus 7, Ohio.*

Circuit Breakers (25)

Three new adaptations of this line of low voltage air circuit breakers rated at 40 to 600 amps, 25,000-amp interrupting capacity at 600 volts ac (LA-25) and 200 to 1600 amps, 50,000-amp interrupting capacity at 600 volts, ac (LA-50) have been announced. Adaptations are pull-out type individual enclosures for wall

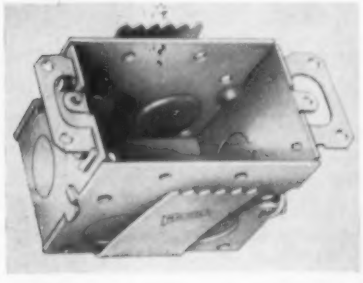
mounting, separate breakers for frame or panel mounting, and skeleton enclosures for use by switchboard builders. In wall mounted breaker, removal of a deep front cover exposes entire breaker for inspection and maintenance. Equipment is available in general purpose, dustproof and weatherproof models. Separate breakers for switchboard installation have an arrangement for stationary mounting, studs drilled for cable lug attachments and a flat front plate or panel as an optional feature. Skeleton enclosure units feature draw-out type construction, a reversible door panel which permits door to be closed while breaker is in disconnect position.

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wis.

Foot Switch **(26)**

A low cost foot switch for a wide variety of light duty uses. Applications range from controlling home workshop tools to small industrial machine tools—applications in which the heavy duty industrial type foot switch is neither required nor economically justified. Identified as Class 9002 type CG-1, the 2-pole device with double-break contacts can be used to control a 1 hp motor at 110 or 220 volts ac.

Square D Company, 4041 North Richards St., Milwaukee 12, Wis.



Switch Box **(27)**

A new switch box designed for installation on "old-work" jobs has been introduced. Griptite box can be used on any type wall—wood, wallboard or plaster. Made of heavy gauge metal. Box anchors securely by means of an exclusive wing-type support which features a "one-screw" adjustment.

All-Steel Equipment, Inc., Aurora, Ill.

SMALLEST in SIZE
BIGGEST in FEATURES

15 AMPERE — 120 VOLT AC ONLY
LISTED AS STANDARD BY UNDERWRITERS' LABORATORIES

ARROW AH HART
Junior Quiette SWITCHES

SCREW OR SCREWLESS TERMINALS

You'll like the Junior Quiette Switch for its small size that means ample wiring room . . . for the built-in shunts in some models that eliminate splicing . . . and a choice of either Binding Screw or Screwless Wire-Lock Terminals, as you prefer.

And when you add to these time-saving and money-saving advantages, features like noiseless operation, silver alloy contacts, an "L" rating for 15 amperes, 120 volts, you'll agree A-H Junior Quiette Switches are a must on the next job . . . and all jobs to follow.

Available in single pole, double pole, 3-way and 4-way with Ivorylite or Brown handles. Listed as standard by Underwriters' Laboratories.

Write for free folder (Form A-198), "A-H Quiette Switches Meet Every Lighting Requirement."

ARROW AH HART
Wiring Device Division
THE ARROW-HART & HEGEMAN ELECTRIC CO.
103 Hawthorn Street, Hartford 6, Connecticut
Offices, Sales Engineers and Warehouses in Principal Cities
Quality WIRING DEVICES • MOTOR CONTROLS • ENCLOSED SWITCHES • APPLIANCE SWITCHES

C-o-o-l OPERATION *through* SCREEN VENTING

Yes, cooler, safer and more trouble-free operation—longer and better protection—with Pierce Fuses! Their venting permits free flow of air through the interior—keeps fuses 10 to 40% cooler—prevents afterblow by permitting dangerous gases and pressures to vent if a link lets go to protect equipment.

Pierce quality is recognized. Their tubular bridge, for instance, assures continually correct knife blade alignment and perfect clip contact. Cases last 6 to 8 times longer. All Pierce quality Fuses are equipped with the famous Balanced Lag Links. Yes, Pierce offers you fuse protection that is unequaled.

It Pays YOU

It Pays YOUR CUSTOMERS

TO STANDARDIZE ON

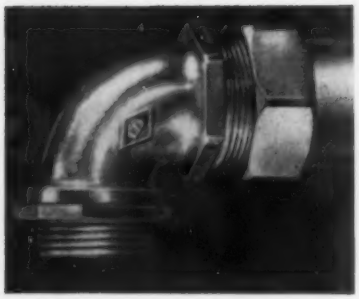
PIERCE

QUALITY FUSES

(Also a complete line of quality non-renewable fuses.)

WRITE TODAY for this helpful booklet on fuses that positively avoid afterblow.

PIERCE RENEWABLE FUSES, INC. LEICESTER NEW YORK



Connectors (28)

New 90° and 45° no-thread connectors, designated as 1770 and 1780 respectively. A complete installation takes seconds. Nut is backed off, conduit is inserted and nut re-tightened, hand-tight. A specially designed gland ring with multiple serrations bites into conduit. When nut is tightened, gland ring is forced into a tight grip on conduit. Connection to box is made through a standard lock nut. Connectors are made of malleable iron. Gland ring is steel. 90° and 45° variations can be applied for rigid conduit sizes from ½-in. to 1¼-in.

Electrical Fittings Corp., 37-50, 57th St., Woodside 77, N. Y.

Bushing Cap (29)

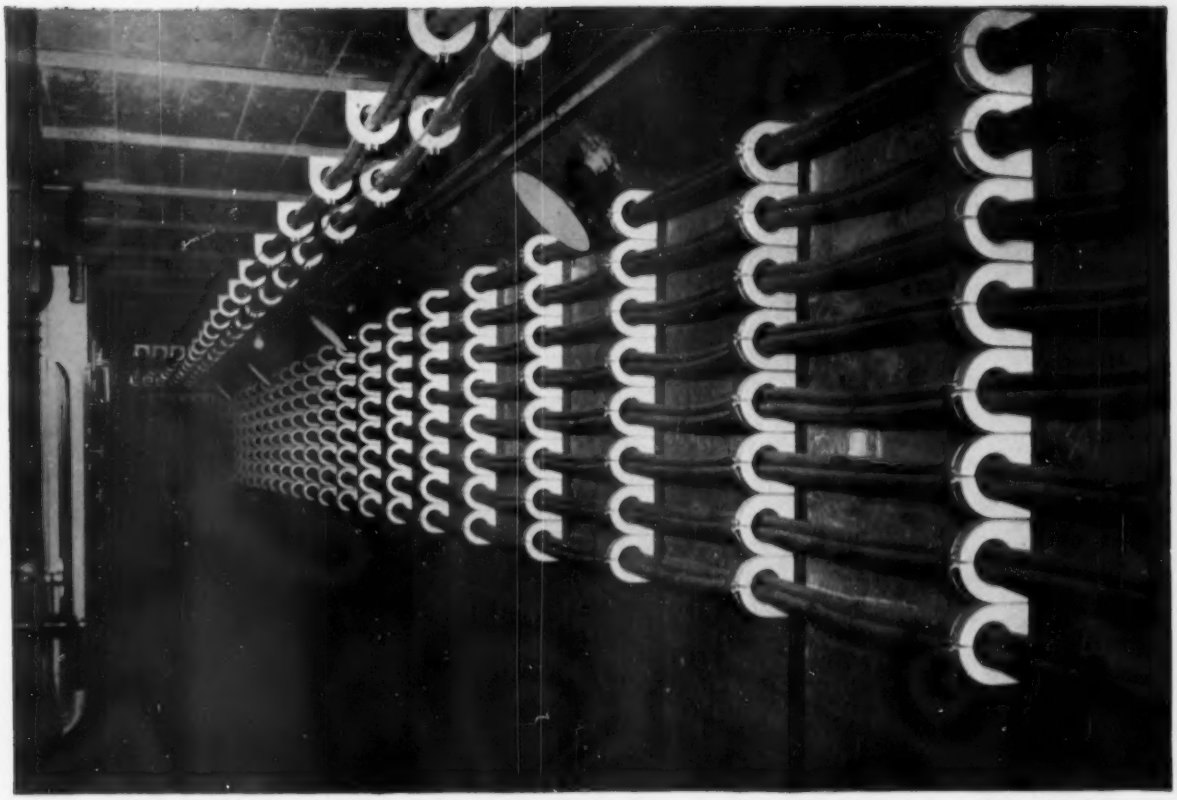
A new versatile plastic bushing cap that snaps into conduit bushings, insulated bushings, connector hubs and conduit ends both rigid and EMT. Easily installed with only finger pressure, the new cap assumes its original shape and size to form a tight protective seal during construction work. The plastic cap, unlike metal seals, may be snapped into either metal or plastic bushings. All installations can be made in the field. Bushing cap is available in all conduit sizes, from ½ to 2 in.

The Thomas & Betts Co., 36 Butler St., Elizabeth, N. J.

Power Conversion Units (30)

An extended line of selenium ac to dc power conversion units with single-unit ratings to 125 kw. The new unit ratings are 50, 75, 100 and 125 kw. Each rating is offered in either 125 or 250 volts dc, with other voltage ratings available on special order. Applications include dc power for cranes, hoists, shop machine tools, etc., in industry, for printing press drives, and for elevators or other equipment in commercial buildings. Unit can also be used for synchronous motor excitation. Construction features standard with all unit ratings include G-E Vac-u-Sel rectifier stacks and the absence of moving parts, except for ball bearings in the cooling fans.

General Electric Company, Lynn, Mass.



for maximum dependability . . .

world's most modern shell plant specifies KEYSTONE 5KV CABLES

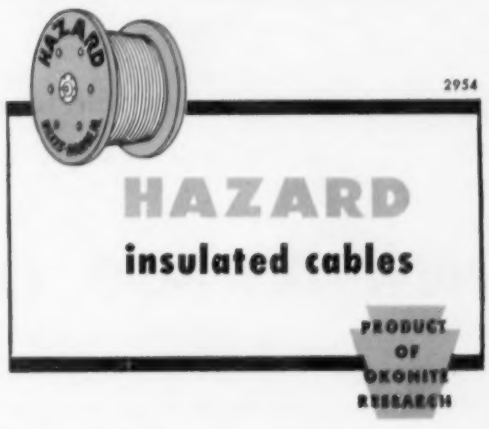
Available with either copper or aluminum conductors

Nothing was spared to provide the surest and most adequate supply of electrical energy for the huge motors, pumps and other equipment that make the Scranton Ordnance Plant, operated by the United States Hoffman Machinery Corporation, the largest and most modern of its type in the world.

In production less than 18 months after the project was approved, the plant makes extensive use of Keystone-Hazaprene 5kv non-shielded cable.

A typical application of this top-quality, yet economical cable is found in the plant's forge shop. There, 1/conductor 750,000 mcm Keystone-Hazaprene 5kv non-shielded cables feed power from 3 - 5000 kva transformers to 12 - 600 hp and 12 - 450 hp pumps which provide hydraulic pressure for the main drawing and forging operations. These dependable power feeder cables are installed in interconnecting underfloor tunnels like the one shown above.

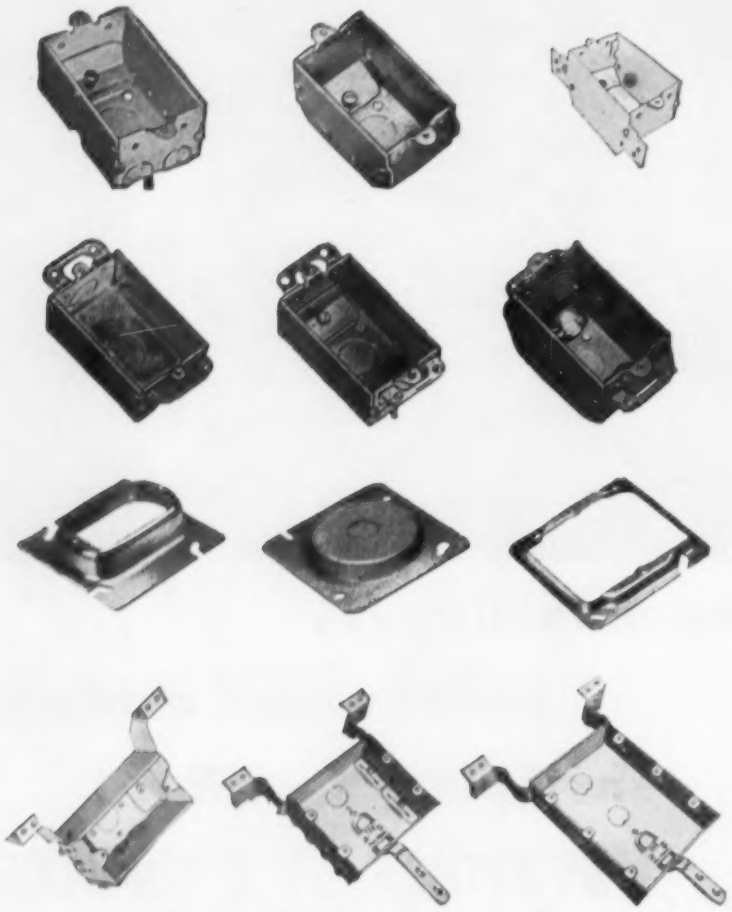
You, too, can use Keystone cables to advantage in your operation. Ask for Bulletin EC-463 for full details or write Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.



SOLID SWITCH BOXES

Newart Solid Switch Boxes tested and accepted for the severest installations

A SOLID SWITCH BOX FOR EVERY PURPOSE



Pioneers in Solid Switch Boxes that have proven time savers. Ideal for installations of special devices such as Power Receptacles—Range Receptacles, etc. without the need of a box cover; switch plate only.

ALSO A FULL LINE OF

OUTLET BOXES—SWITCH BOXES—OUTLET BOX COVERS—BAR HANGERS

Sold exclusively thru Electrical Wholesalers.

NEWART MFG. COMPANY

6725 Machinery Ave.

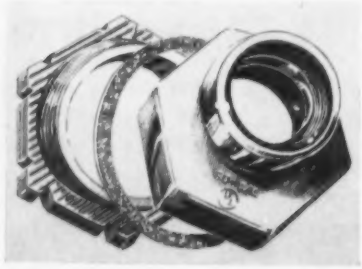
CLEVELAND 3, OHIO

Newart Sales Offices and Warehouses assure prompt and efficient Service

Switch Dial (31)

The one time switch dial permits setting of full week's schedule for automatic On-Off control operations on a varied daily program. Requiring a full week to make one complete revolution, the dial will accept screw-on trippers at even 2-hour periods in each of its daily segments. These screw-on trippers for On-Off action also permit manual operation of the time switch, if desired, without the need for relays. Use of the 7D1191 makes possible the starting and stopping of a given operation at different times each day, as well as to eliminate all operations on Sundays or weekends.

Tork Clock Company, Inc., Mt. Vernon, N. Y.



Conduit Hubs (32)

"Sur Ground" conduit connector hubs for single or multiple connections to metal service and distribution housings incorporate patented grounding and self-locking principle. Constructed of lightweight, high-strength aluminum alloy, these weather-resistant and raintight hubs are UL approved and available in stock conduit sizes, ½ to 6 inches, and blind cover.

So-Cal Electro Products, Inc., 4423 W. Jefferson Blvd., Los Angeles 16, Calif.

Attic Fan (33)

A new series of Ventura attic fans, designated Model CA, for residential installations. The V-belt drive design operates at low fan speed. The fan wheel rotates on precision ball bearing mountings and motor is mounted on resilient rubber cushions which dampen vibration and guarantee op-

eration at minimum sound level. They are available in eight sizes having rated capacities from 4400 to 21,500 cfm at zero static pressure. Nominal wheel diameters are from 24 in. to 48 in.; hp ratings are from 1/6 to ¾. Fans having wheel diameters of 24 in., 29 in. and 36 in. are available equipped with sheet metal side panels for ceiling installation.

American Blower Corp., Detroit 32, Mich.

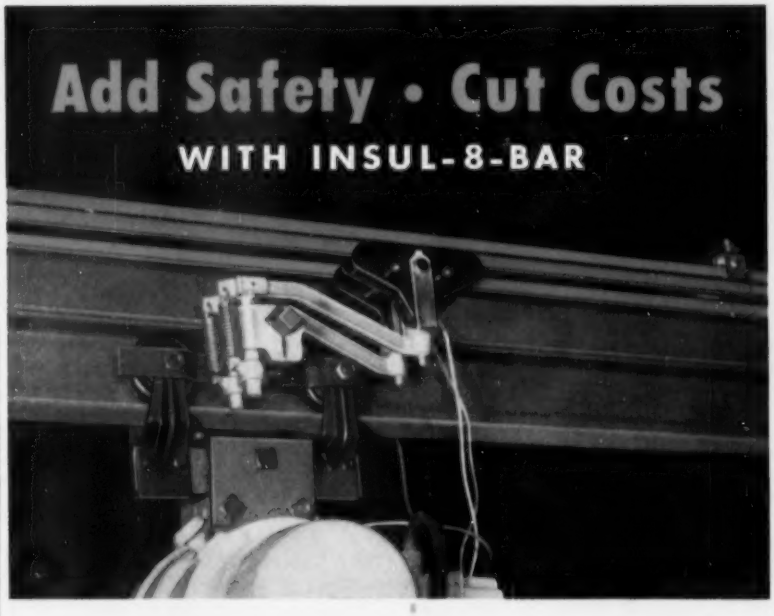
Variable Speed Drive (34)

A new variable speed drive known as the "Selectron", offers a wide speed range, compactness, a patented load compensating circuit for close speed regulation, simple installation, stepless control, fast speed response, easy maintenance. Normal speed range is 22 to 1 but is available in speed ranges as great as 60 to 1. With tachometer feedback, speed can be controlled to within ¼ of 1%. Power supply is from ac single phase voltages of 110, 208, 220, 440 or 550 at 50 or 60 cycles. Separate transformers for other voltages are available. Drive motors are of heavy duty, ball bearing industrial type in standard NEMA frames.

Electro Dynamic Division of General Dynamics Corp., Bayonne, N. J.

Grounding Receptacle (35)

A new tandem slot grounding receptacle and tandem blade cap, specifically for use with air conditioners and other 250-volt, 15-amp equipment. When used only on 250-volt circuits, as recommended by UL, they will prevent accidental connection of 125-volt equipment to higher voltage outlets. The wiring devices include a No. 1440 duplex 3-wire receptacle; No. 1445 single 3-wire receptacle; and



Mobile Safety Electrification

FOR CRANES, MONORAILS ALL MOVING MACHINERY

Insul-8-Bar guarded conductor systems eliminate the hazards of bare electric conductors. Their cost is relatively low, yet they fully satisfy all safety requirements — legal and otherwise — of modern plant operation.

● *Economical:* simplicity contributes to low purchase price, installation and maintenance costs.

● *Versatile:* conductors can be placed as close as 1¼" centers — side by side, horizontally, or vertically.

● *Flexible:* the systems are designed to negotiate any type of curve, switch, or interlock.

● *Capacities:* the same basic size conductor is available in capacities of 100 Amps. to 500 Amps. without change in accessories or clearances.

These are the only systems (insulated *or* bare) that meet all requirements of crane, monorail, and moving machine electrification.

For low cost safety, easy installation, and trouble-free performance, specify and use Insul-8-Bar. Write for catalog and technical data.

Collectors

Trolley-type, sliding shoe collectors are available in capacities and mountings to meet all requirements. There are no exposed current carrying surfaces.

Conductors

Plastic "Geon" sheath covers the 1" figure 8 conductor bar. Cover is not affected by moisture, sunlight or chemical agent. It meets all requirements for thermoplastic electrical insulation. Although rigid, it may be curved on the conductor bar at time of field installation.

INSUL 8 BAR

INSUL-8-CORP.

1369 Industrial Road
San Carlos, California
Representatives in all major cities.

3 QUAD

GIVES YOU 3 INSTALLATION ADVANTAGES...

1 EXCLUSIVE MULTIPLE MOUNTING THAT SAVES TIME AND LABOR . . .

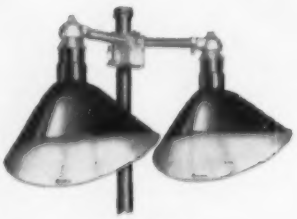
2 130 UNITS TO COVER WIDEST INSTALLATION NEEDS

3 EACH A DIFFERENT SIZE OR SHAPE OF REFLECTOR, CHARACTER OF LIGHT DISTRIBUTION OR MOUNTING METHOD

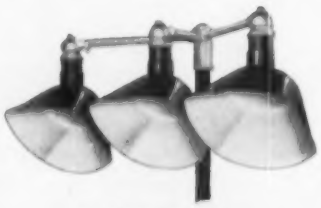
Floodlighting installations are made a lot easier with this well designed, complete line. Units of one, two, or three reflectors can be mounted on a wood pole, iron pipe, or any vertical surface.

The user gets individual light control with each unit which can be turned or tilted in any direction. A single head bolt permits adjustment of 180 degrees horizontally and 40 degrees vertically. Units of various sizes and types can be removed or interchanged without disturbing the wiring.

SCOOP



ELLIPTICAL



RECTANGULAR

FOR COMPLETE DETAILS ASK FOR

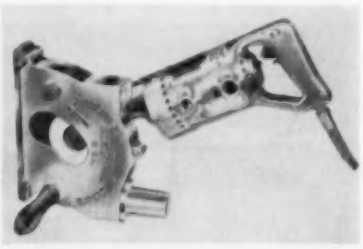
FLOODLIGHT CATALOG 9-A

QUADRANGLE MFG. CO.

325 S. PEORIA ST. CHICAGO 7, ILL.

No. 63 armored 3-wire cap. Tandem slot arrangement makes it impossible to connect a parallel blade, 125-volt attachment plug to receptacles. Receptacles and cap carry UL seal. Receptacles are also furnished on 3-in. and 4-in. covers.

John I. Paulding, Inc., New Bedford, Mass.



Groover **(36)**

Electric plaster groover facilitates the laying of conduit and EMT in plaster, lath, brick or concrete. The tool consists of a special motor-driven 6-in. abrasive wheel with adequate guard and support handle which makes a single cut up to 1¾ in. in depth. The guard is equipped with a nozzle for attaching the hose of any commercial vacuum cleaner for the convenient removal of dust during operation. The entire unit is 18 in. long and weighs only 16 lbs.

Wodack Electric Tool Corp., 4627 W. Huron St., Chicago 44, Ill.

Fastening Tool **(37)**

Manually operated Shure-Set fastening tool seats a specially constructed fastener into such materials as concrete, concrete block, cinder block, brick and steel. Using it, a worker can manually drive a fastener through ¼-in. steel. Packaged in a

Redegee Benfield Bender used in demonstration

We had lost the order . . .

then our salesman started bending pipe

We had lost a big order on price—almost. Then our salesman got mad. He decided to *prove* that Sherarduct rigid steel conduit should be specified. So he went out and picked up a bender and some lengths of Sherarduct. Back in the customer's office he started making bends . . . then the customer tried a few himself.

Result: we got the order. The customer didn't need an adding machine to figure out the savings in labor he'd get from Sherarduct's easy bending qualities.

Easy bending is one reason Sherarduct is preferred by so many cost-conscious contractors. There are others, like easy fishing, lifetime protection against corrosion, zinc protected threads, strong couplings and thorough grounding. They're features that add up to why Sherarduct is galvanized conduit at its best.

Next time an NE salesman calls, give him a chance to prove Sherarduct—by actually bending some pipe.

Meantime, write for our Sherarduct facts book and get complete information on the Sherardizing process of dry galvanizing that actually alloys zinc with the steel wall of the conduit.

Sherardizing is galvanizing at its best . . . Sherarduct is galvanized conduit at its best

Listed by Underwriters' Laboratories, Inc.

National Electric Products

PITTSBURGH, PA.

3 Plants • 10 Warehouses • 36 Sales Offices

NEW Furnas Electric SIZE 4
MAGNETIC CONTROL

Rated for
50 HP 220 volts
100 HP 440 volts

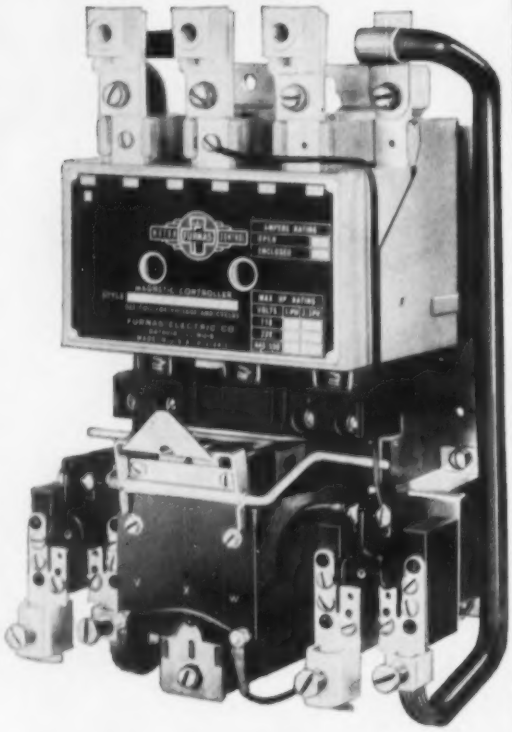
Arc Box Cover Easily Removed To Inspect Contacts

Dual Voltage Magnet Coil

All Contacts Are Easy To Replace. No Wires To Remove

Contacts Are Locked In Open Position When Reset Button Is Operated

Switchlets Easily Attached For Additional Circuits



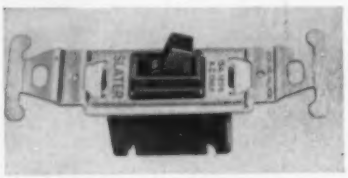
COMPACT—STANDARD DESIGN—DUAL PURPOSE

Years of engineering and field testing are built into the Furnas Electric size 4 magnetic starter. Compare these features: COMPACT—The new size 4 starter is only slightly larger than the size 3. STANDARDIZED DESIGN—Non-current carrying elements such as magnet assembly, arc box, cross arm, mounting plate and the like are interchangeable with the size 3. This standardization has been made without compromising on life because larger contact and other current carrying parts provide the increased capacity. DUAL PURPOSE—Reconnectable dual voltage coils. A single starter stocked with its coil connected for 220 volts can be quickly and easily reconnected for 440 volts. Coil changing is eliminated and stocking of starters and coils simplified.
Write for Bulletin 5604, Furnas Electric Company, 1067 McKee Street, Batavia, Illinois

FURNAS ELECTRIC COMPANY
BATAVIA, ILLINOIS
SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

metal carrying kit, the tool includes long and short collars, ¾-in. and ⅞-in. stud holders, and drive rods. The anvil or head of the tool, when hit with a hammer, drives the fastener securely into the surface. Hand guard protects fingers; leveling plate protects the user from flying splinters.

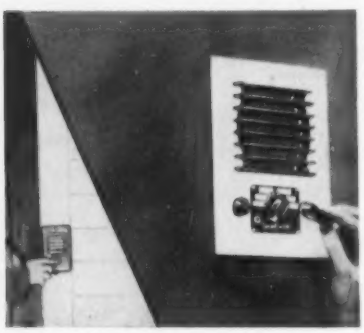
Olin Mathieson Chemical Corp., 460 Park Ave., New York 22, N. Y.



Switch (38)

A new switch, known as the 600 Series of Quiet Switches, provides noiseless operation for incandescent and fluorescent lights. The line is rated 15 amps, 120 volts ac; 15 amps, 277 volts ac; and 20 amps, 120 volts ac; 20 amps, 277 volts ac. They can be mounted in any position. Available with speed wire (rear wiring) with patented side release or with screw terminals. Choice of 3-wire system or built-in shunt, single pole, double pole, 3-way and 4-way. Construction features include special silver alloy contacts, extra-heavy plated steel strap, plaster ears and Bakelite case —takes No. 12 or No. 14 wire.

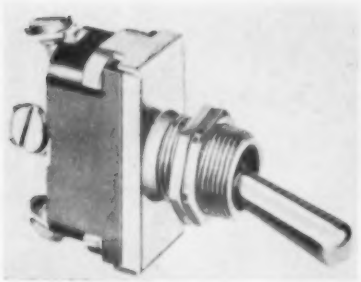
Slater Electric & Mfg. Co., Woodside, L. I., N. Y.



Intercom System (39)

A new Teletalk intercom for the home consists of a pair of two-way, flush-mounting speaker-microphone units made of weatherproof brass, one to be set into the outside wall next to the front door, the other to be installed anywhere in the house. Front door unit has separate pushbutton which connects with the doorbell or chime. Using the device, the housewife can "screen" callers without unlocking the door. Stations in the kitchen, laundry and upstairs bedroom enable the resident to answer the front door from almost anywhere in the house, an installation consisting of up to 10 units being possible.

Webster Electric Co., Racine, Wis.



Toggle Switches **(40)**

A new line of 15-amp single and 2-circuit toggle switches designed for ac operation. Models are available in three separate switching arrangements. Model 90 is a single-pole single-throw switch designed for on-off operation. Model 91 is a 2-circuit, single-pole, double-throw switch with a center "off" position. Model 92 is a 2-circuit unit similar to 91, except that it throws directly from one circuit to another with no "off" position. All are rated for ¾ hp capacity and for 15-amp service at 125 volts, or 10 amps at 250 volts. Switches are available with screw terminals, soldering lugs, or spade terminals to fit AMP 41202. Dimensions are: ½-in. wide, ½-in. thick, and 1¼-in. long. The threaded nipple is 7/16-in. long.

McGill Manufacturing Co., Inc., Valparaiso, Ind.

Time Switch **(41)**

A new general-purpose time switch, TSA-40, suitable for indoor and outdoor use, will turn electric circuits on or off at any time of day. Feature is the shearing action of the contacts which are forced to slide against each other as they open and close. Operator safety is increased by dead-front construction. It has a 4-watt motor with permanent silicone-grease lubricant sealed in. Switch is furnished with either a plain dial for fixed time setting or an astronomic dial for dusk and dawn schedules. One or more days may be skipped during a week of operation with the use of an omitting device.

General Electric Co., Schenectady 5, N. Y.

FOR FINEST QUALITY IN
Sound Systems
Time Signals
Public Address *and*
similar applications

WB
SHIELDED WIRE *and*
INTERCOMMUNICATIONS
CABLES...

ADVANCED DESIGN, HIGHEST QUALITY, DEPENDABLE

SOUND SYSTEM CABLES

Semi-Rigid, Polyvinyl Chloride Types. These wires have excellent insulation resistance and electrical stability under high humidity conditions. Semi-rigid Plastite® insulation is tough abrasion resistant and flame resistant. Types available: solid and stranded conductor; semi-rigid vinyl or enamel textile insulation; bare or tinned copper shield. With or without cotton braids or vinyl jacket.

INTERCOMMUNICATION CABLES

TELECABLE® Multiconductor Paired Inside Wiring Cable. Furnished in #24 AWG in 6, 11, 12, 16, 21, 26, 32, 51 and 76 pairs, and in #22 AWG in 6, 11, 12, 16, 26, 32 and 51 pairs. These cables have semi-rigid Plastite insulation and brown or ivory Plastite jacket. They are light weight, easy to install, have excellent insulation resistance and are unaffected by humidity. The color-coded polyvinyl chloride insulation does not tend to cold flow even when the cable is bent sharply as it often is when placed in conduit.

SIGNAL WIRE

Bare soft copper conductors insulated with high dielectric strength polyvinyl chloride insulation. Underwriters' Laboratories approved for fire and burglar alarm system internal wiring.

AND A COMPLETE LINE OF MICROPHONE CABLE

Write for FREE catalog SW-1

WB *HAS* that which so many others have yet to gain . . . EXPERIENCE

WELL BUILT WIRES SINCE 1899

©1956
WHITNEY BLAKE COMPANY

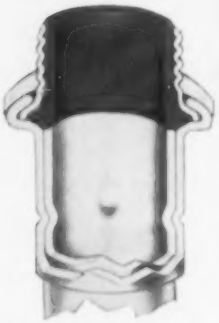
NEW HAVEN 14, CONNECTICUT

B-M INDENTER TYPE FITTINGS

FOR E.M.T. Concrete-tight

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job.

Red Throat
Insulated Connector



Red Throat
Cross section

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!

B-M COMPRESSION TYPE FITTINGS FOR E.M.T. Rain-tight

SIZES FROM ½" to 2"

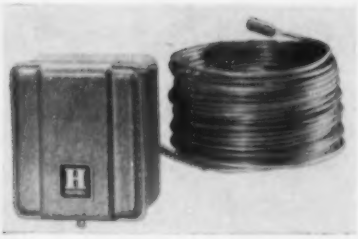
SIZES FROM ½" to 2"

SIZES ½" ¾" 1"

SIZES ½" ¾" 1" 1¼"

SIZE ½"

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS



Control **(42)**

A new electronic thermostat that features a 27-ft temperature-sensing element. It is designed to solve the problem of temperature stratification in large air ducts. The long temperature-sensing wire is enclosed in ¼-in. copper tubing. This permits it to be arranged to "feel" the average of stratified temperatures such as exist in large heating and air conditioning ducts in commercial buildings. It can also be used to give average readings of concrete slab temperatures in radiant floor panel heating systems. The instrument, designated L7022A, has an operating range from minus 30 to 225 degrees F. It can be used with any standard M-H electronic or electronic-pneumatic control system.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Product Briefs

(43) Frigid, Inc., Brooklyn, N. Y. has developed an electrically reversible pushbutton 20-in. Venturi **window fan.**

(44) A new type of fluorescent **lamp starter** with a ceramic condenser has been developed by Sylvania Electric Products, Inc., Salem, Mass. . . . (45) Sola Electric Co., Chicago, Ill., has announced the redesign of three capacities of their standard type constant **voltage transformers.** . . . (46) Model 420 **centrifugal switch** is especially designed for grain elevators and feed mills. It is manufactured by Ralph C. Gardner & Co., Fort Wayne, Ind.

(47) A newly developed portable electric power unit, the Portopower **voltage booster,** has been designed to deliver the additional voltage required in construction work where power tools are used. It is manufactured by Portopower Division, Ferndale, Mich. . . . (48) S&C Electric Company, Chicago, Ill., has announced that metal-clad equipment **enclosures** are now available in two finishes, the "Durabake" and "Super Durabake". . . . (49) Ballymore Company, Wayne, Pa., has developed a new hydraulically-operated **work platform.**

(50) A new battery-powered utility **lantern** has been developed by Burgess Battery Co., Freeport, Ill. . . . (51) An outdoor **thermostat control** that tips off the indoor thermostat to changing weather conditions is now available from the General Electric Company, Schenectady, N. Y. . . . (52) Pioneer Plastics Corp., Peabody, Mass., has

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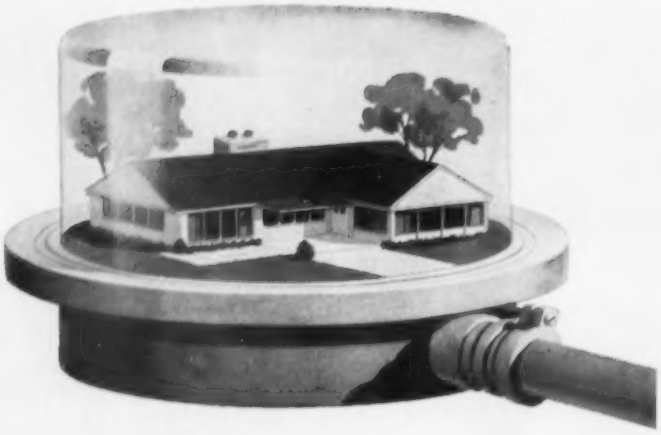

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Electric Home Heating is the dramatic new use of electric power that is capturing the imagination of home owners and buyers all over America. Paced by the fabulous growth of the electrical industry, it has all the Sales Magic of a sensationally new and different way of heating.

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Never before has so much interest and attention been focused on the benefits of electric living. Industry promotions such as "Housepower" and "Live Better Electrically" are helping to pre-sell better wiring and increasing uses of electricity. These efforts mean plus business to Electrical Contractors. Each home wired for 240 volt service is wired for electric heat. In addition, many major utilities are revising rate structures to promote the installation of supplemental Electric Home Heating. You are right in the middle of an important and growing NEW electrical market when you are in the Electric Home Heating business.

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FIRST NAME IN ELECTRIC HEAT

developed a **washer** to clean and destaticize light diffusers of rolled corrugated vinyl, Wakon, Sylvan Aire, etc.

(53) Robertson and Ruth, Elmhurst, Ill., has developed a Model 500 **dial saw**, a new industrial wood and metal working tool for use with heavy duty equipment. . . . (54) A new **wound-core** for its complete line of distribution transformers has been introduced by RT&E Corporation, Waukesha, Wis. . . . (55) Industrial Automation Corp., Chicago, Ill., has developed a new Model CT-100 cartridge type thermostatic **detector** unit.

(56) A portable **Gantry**, using a high strength aluminum alloy I-Beam has been announced by B. E. Wallace Products Co., Exton, Pa. . . . (57) The first of a new series of Ultrasonic **degreasers** has been announced by the Industrial and Scientific Products Division of Curtiss-Wright Corp., Caldwell, N. J. . . . (58) Five new, residential, fluorescent lamp **ballasts** with size, weight and price reductions have been developed by the General Electric Company, Schenectady, N. Y.

(59) Vemaline Products Co., Hawthorne, N. J., has developed a "B" series **footswitch**. . . . (60) A new adjustable **manhole shield** is available from T. J. Cope, Inc., Collegeville, Pa. . . . (61) A small oil tight sheet metal **wiring box** particularly suitable for use with flexible, liquid tight electrical wiring conduit, is available from Hoffman Engineering Corp., Anoka, Minn.

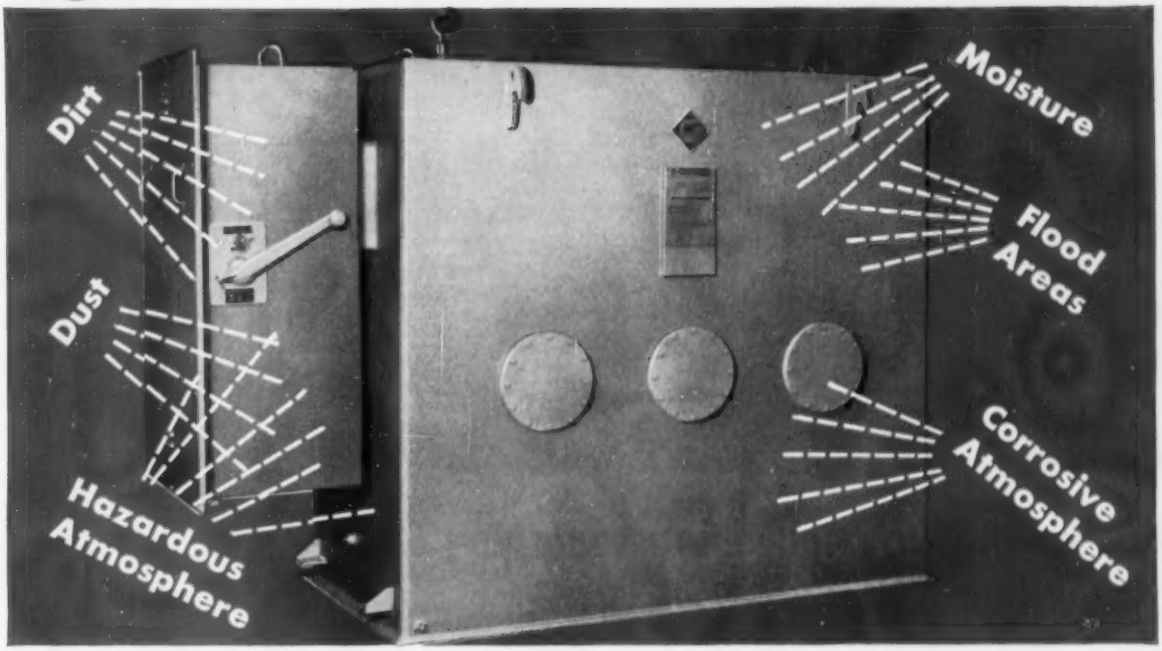
(62) The Dynaseal Lighting Corp., Cambridge, Mass., has developed a Lifetime DY-1006 **emergency light** specifically designed for both new and old construction. . . . (63) A complete line of vinyl **electrical tape**, trade named "Porter", is manufactured by Quaker Rubber Division, H. K. Porter Company, Inc., New York City. . . . (64) Three new **motors**—two rated at 10 hp and one at 15 hp—have been engineered by Robbins & Myers, Inc., Springfield, Ohio, and added to its full line of All-Weather, capacitor single phase motors.

(65) Keystone Manufacturing Co., Center Line, Mich., has announced that its flangeless screwcover **wireways** are now available in special sizes. . . . (66) Electric Re-Light Company, Rochester, N. Y., has developed a **fluorescent lighting tester**. . . . (67) A new 6900-watt multiple **relay** has been announced by Ebert Electronics Corp., Queens Village, N. Y.

(68) A new agitator **belt drive** unit has been announced by Little Giant Products, Inc., Peoria, Ill. . . . (69) Signal Transformer Company, Brooklyn, N. Y., has announced the utilization of new **transformer** manufacturing methods that result in size and weight reduction. . . . (70) Wincharger Corp., Sioux City, Iowa, features a new idling development, called the

ALLIS-CHALMERS
Sealed
Dry-Type
Transformers

Designed for the *Toughest Spot* In Your Plant



SAFE in any location regardless of Atmosphere or Moisture Conditions

Here's a transformer you can safely install anyplace without worries.

● **Fire or Explosion Hazard Eliminated** — Unit is hermetically sealed in inert-dry-nitrogen atmosphere.

● **Completely Protected**—Can be placed safely in flood areas, dirty and contaminated atmospheres, or in open work areas without vaults or barriers.

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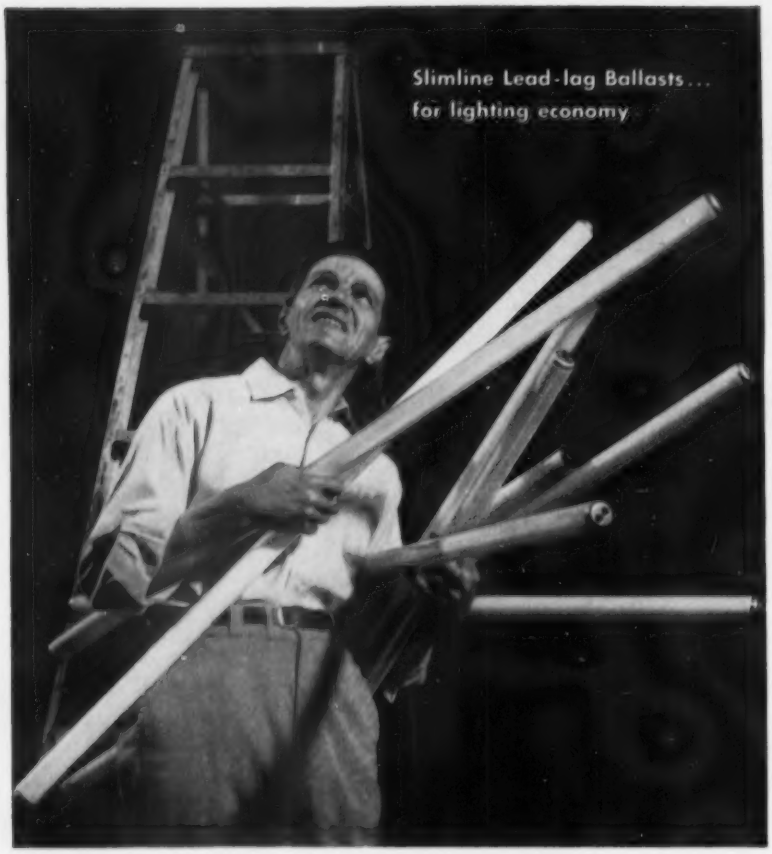
● **Maintenance Requirements Cut** — Elimination of cooling tubes and use of smooth tank surface reduce paint area as much as 60%. No internal liquids to maintain. All-welded construction. Number of gasketed openings reduced. Cleaning of core and coil eliminated. For these reasons, unit can be installed in hard-to-get-to places.

● **Low Installation Cost** — Unit is ready to be energized immediately upon delivery, after check to make certain no damage or leaks have occurred during shipment.

Allis-Chalmers transformers have an outstanding record of satisfying thousands of users all over the country. You can get the complete story on Allis-Chalmers sealed dry-type transformers from your local A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5035



Know what his confusion costs you?

Here's a maintenance man with a serious problem. His job—replace a defective lamp in a lighting fixture equipped with a series slimline ballast. One lamp has burned out causing the other to burn dimly or go out completely. But which is the defective lamp—shall he guess or test. Either way, you lose time and money from his confusion.

With Westinghouse slimline *lead-lag* ballasts, when one lamp burns out the other lamp is not affected. Your maintenance man knows at a glance which lamp to replace. He can perform his job quickly and efficiently without throwing out good lamps.

And you get an extra plus with Westinghouse slimline *lead-lag* ballasts. The exclusive UI design means cooler, quieter, and more efficient operation. For complete details about this unique ballast, see your Westinghouse representative. Or write Westinghouse Electric Corporation, Lighting Division, Edgewater Park, Cleveland, O.

J-04401

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING TODAY!

Conserv-er on its Winco 2500-watt direct-drive engine-generator.

(71) A new circuit breaker interrupter **transfer switch** has been announced by Lake Shore Electric Corp., Bedford, Ohio. . . . (72) A new Auto-Tension **motor base**, which automatically compensates for belt stress and maintains exact belt tension for all load conditions, is available from Lovejoy Flexible Coupling Co., Chicago, Ill. . . . (73) A new Sentry-Lite designed to provide instant automatic **emergency light** over large areas, if power is interrupted, has been introduced by Hobby and Brown Electronic Corp., Rockville Centre, N. Y.

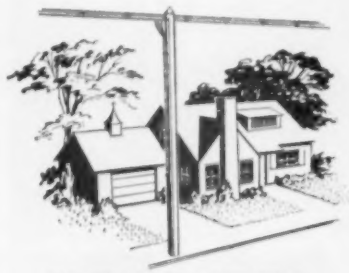
(74) A new cable supporting riser **elbow** has been added to other standard fittings in the expanded metal cable trough system, manufactured by T. J. Cope, Inc., Collegeville, Pa. . . . (75) A new shallow on-ceiling incandescent **diffuser**, named Berkeley Square, has been introduced by Peerless Electric Co., San Francisco, Calif. . . . (76) A new 1/25 watt neon **pilot light** has been developed by Pass & Seymour, Inc., Syracuse, N. Y.

(77) A new line of phenolic-handled **lamp guards** in either 2- or 3-wire styles are now available from the McGill Manufacturing Co., Inc., Valparaiso, Ind. . . . (78) Two additional sizes have been added to the Softlight **incandescent lamp** line by Sylvania Electric Products, Inc., Salem, Mass. . . . (79) A new line of high bay mounting **lighting units** for mercury and incandescent lamps have been announced by Electro Silv-A-King, Chicago, Ill.

(80) A new load pick-up **switch** (Type LP) that serves as an automatic load-shedding and load-restoring device is available from the Westinghouse Electric Corp., Pittsburgh, Pa. . . . (81) A new 7500-watt ac, air-cooled, gasoline-powered electric **generating plant** has been developed by D. W. Onan & Sons, Inc., Minneapolis, Minn. . . . (82) Ceramic **radiant heat panels** that can be suspended from the ceiling are available from Heatmore, Inc., Brooklyn, N. Y. for commercial and industrial applications.

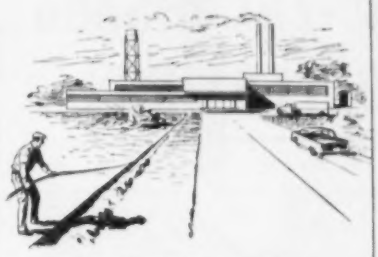
(83) General Electric Company, Cleveland, Ohio, has announced that 40-watt rapid-start **fluorescent lamps** are able to flash on and off like incandescent light bulbs. . . . (84) Duro-Test Corporation, North Bergen, N. J., has developed a new **fluorescent** "Color Matcher" unit. . . . (85) A new 7-day **time switch**, 5B, automatically regulates a complex weekly program involving from 1 to 6 daily on/off operations. It is manufactured by General Controls, Glendale, Calif.

(86) Two improvements have been made to the all electric **cable puller** manufactured by Barth Corp., Cleveland, Ohio.



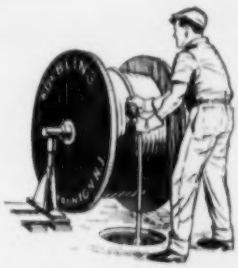
HANG 'EM

IN THE AIR



BURY 'EM

DIRECT



RUN 'EM

IN DUCTS OR CONDUITS

ROEBLING POWER CABLES WITH THE

3-WAY PAYOFF

ROEBLING *Roeprene* Type USE, Style RR Cables were specially designed for direct burial. Non-metallic (Neoprene) sheathed, with either RHW, or RH-RW insulation they are approved by Underwriters' Laboratories as Type USE and conform to National Electrical Code requirements.

These power cables are really *versatile*... remarkably adapted for general use. They meet IPCEA specifications for use in ducts and conduits... and for aerial use.

Roebling *Roeprene* Type USE, Style RR Cables are available in single and multiple conductor construction, sizes 12 to 4/0. Size 14 AWG may be obtained for special applications. Write for full data on these low-cost power cables, and order them from your distributor.

ROEBLING ELECTRICAL WIRES AND CABLES ARE AVAILABLE WITH EITHER COPPER OR ALUMINUM CONDUCTORS

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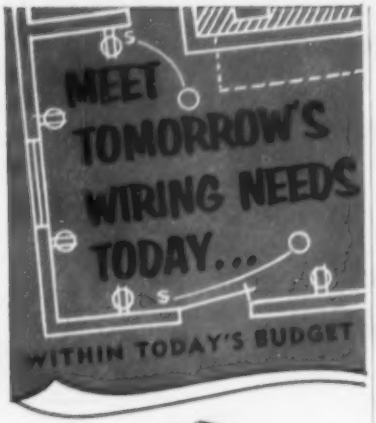
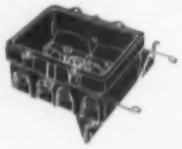


. . . with Union's Non-Metallic Wiring System. (Insulated boxes plus non-metallic sheathed cable.) So economical that contractors can often provide 17% more outlets at no increase in cost over older methods.

Because of the inherent safety features of Union's Non-Metallic Boxes, they are now specified by alert architects in their outstanding residential plans. (Non-Metallic Boxes cannot become energized, rust or change their ground potential over the years.)



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UNION INSULATING CO.
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CATALOGS and BULLETINS

(87) PIPE CUTTERS employing motor-driven abrasive wheels are described in 4-page Form AB-355. Combination unit consisting of pipe cutter and threader mounted on 2-wheel trailer is particularly suitable to construction work. Beaver Pipe Tools, Inc.

(88) VARIABLE-SPEED DRIVES called Texrope are the subject of 44-page booklet 20P50. Design features, hp rating tables and speed range tables are presented along with description of accessory equipment. Allis-Chalmers Mfg. Co.

(89) DRIVE ANCHOR for fastening to masonry is named the Pin-Grip. Integral unit requiring no screws is available in $\frac{3}{16}$-in. and $\frac{1}{4}$-in. sizes. Form 169. Star Expansion.

(90) ADJUSTABLE HOLE SAWS have simple dial arrangement for setting saw to any size from $2\frac{1}{2}$ to 5 in. Bulletin 111, 4 pages. Robertson & Ruth.

(91) PLUGMOLD. Form 589, 12 pages, illustrates a wide range of uses for plug-in strip available in five sizes with capacities up to ten No. 6 wires. Wiremold Co.

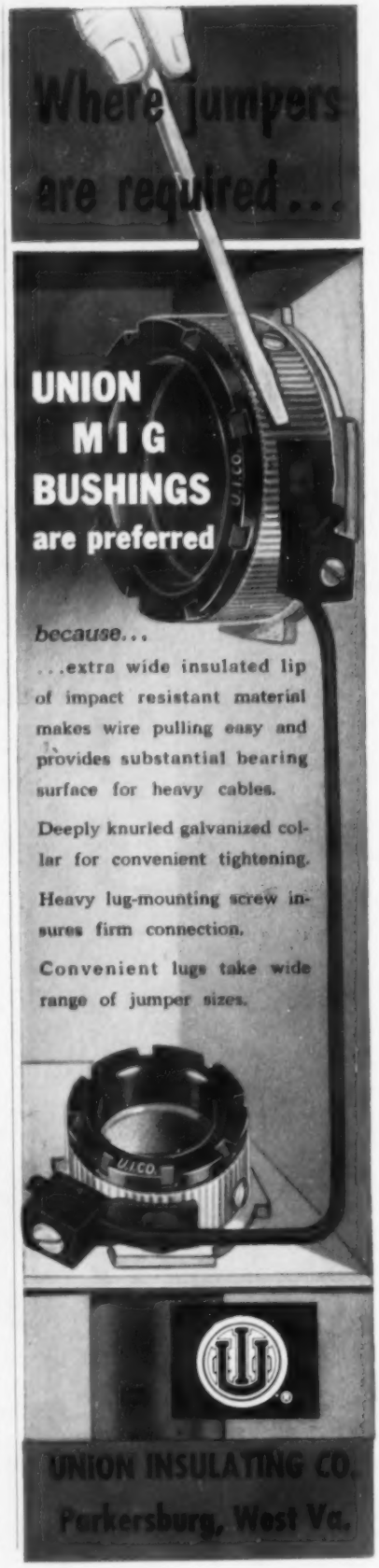
(92) CONNECTORS and a wide range of electrical fittings are listed in a comprehensive 68-page catalog-price book covering fittings for similar and dissimilar metals, ground rods and accessories, terminals and hoists. Jasper Blackburn Corp.

(93) WIRE STORAGE. Portable coil racks designed to reduce warehouse space requirements and to simplify handling are described in 2-page Bulletin R-300. Three sizes available. Jarke Manufacturing Co.

(94) MOTOR CONTROL CENTER. Engineering and application data for new unit accommodating as many as 20 NEMA Size No. 1 plug-in combination starters in standard 90-in. back-to-back section is presented in 28-page Bulletin 2-2000. Federal Pacific Electric Co.

(95) RECESSED INCANDESCENT UNITS. Folio B-60, 20 pages, gives specifications, dimensions and utilization data on complete line of square and round units for lamps to 300 watts. Gruber Lighting.

(96) NARROW PANELBOARDS, designated NP Electri-Centers ac-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UNION
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BUSHINGS
are preferred
because...
...extra wide insulated lip of impact resistant material makes wire pulling easy and provides substantial bearing surface for heavy cables.
Deeply knurled galvanized collar for convenient tightening.
Heavy lug-mounting screw insures firm connection.
Convenient lugs take wide range of jumper sizes.
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commodate up to 32 circuits in standard enclosure. Units are available with matching wireway extensions and top- or front-mounted pull box. 4-page folder. Clampmatic safety switches are listed in 16-page Bulletin SS-260 which covers dimensions, ratings and construction features. BullDog Electric Products Co.

(97) LABORATORY PANEL COMPONENTS, including receptacles, plugs, binding posts, are detailed in 8-page Flexlab Booklet 238. Dimensions and ratings are listed. Standard Electric Time Co.

(98) INDUSTRIAL POWER SYSTEMS. Bulletin GED-3039, 48 pages, gives application, advantages, planning procedures, operation and other data on equipment for industrial distribution. General Electric Co.

(99) RESIDENTIAL LIGHTING. Two 4-page folders describe adjustable and fixed units in brass and copper finishes. Lehrolite, Inc.

(100) AUTOMATIC TRANSFER SWITCHES. Ten factors required for accurate determination of system characteristics and selection of the proper transfer switch are detailed in 16-page Publication 596. Automatic Switch Co.

(101) ELECTRIC HEATERS featuring combined radiant and convection heating are the subject of Form PC-1092, 12 pages. Dimensions, ratings and installation features of floor, wall and baseboard units are included. Cavalier Corp.

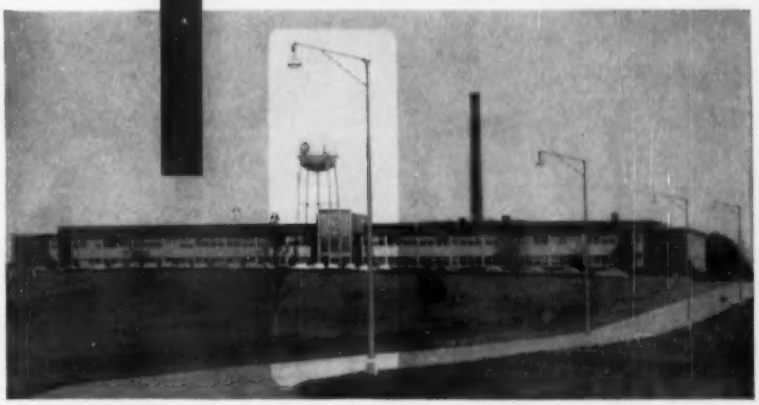
(102) CHURCH LIGHTING. Catalog M-4212, 16 pages, contains illustrated listing of a comprehensive line of pendant, surface-mounted and bracket luminaires with lamp arrangements and dimensions included. Leonard E. Kord Co.

(103) LIGHTING. Condensed catalog CTC-1, 16 pages, gives descriptions and net prices of manufacturer's complete line including floods, weatherproof fluorescents, industrial reflectors and cast aluminum units. Steber Manufacturing Co.

(104) COPPER CONDUCTORS is the title of 62-page booklet C-25 covering characteristics of various shaped buses as well as bare copper and commonly used alloy wires. American Brass Co.

(105) ANNUNCIATOR featuring illuminated window is described in 4-page Electro Pane bulletin which discusses construction, applications and advantages of the unit. Electro Devices, Inc.

AT THE
UNITED STATES STEEL CORP.
RESEARCH CENTER . . .



Servisafe

POLE UNITS
SOLVE LUMINAIRE
SERVICING
PROBLEMS

Maintaining pole-mounted luminaires is a simple one-man job at the handsome new U. S. Steel Corporation Research Center, Pittsburgh, Pa. Each luminaire can be relamped and cleaned *within a few minutes* whenever necessary.

This speed and ease of servicing is provided by Thompson "Servisafe" Pole Units. Featuring a patented foolproof mechanism, they permit an unskilled workman to disconnect and lower a luminaire . . . service it . . . and then reposition it *while standing on the ground.* And there is no electrical hazard because the lowered fixture is "dead".

Decorative as well as functional, "Servisafe" units are the safest, easiest and most economical means of maintaining pole-mounted lights. "Servisafe" Bracket Units for wall or wood pole mountings also are available.

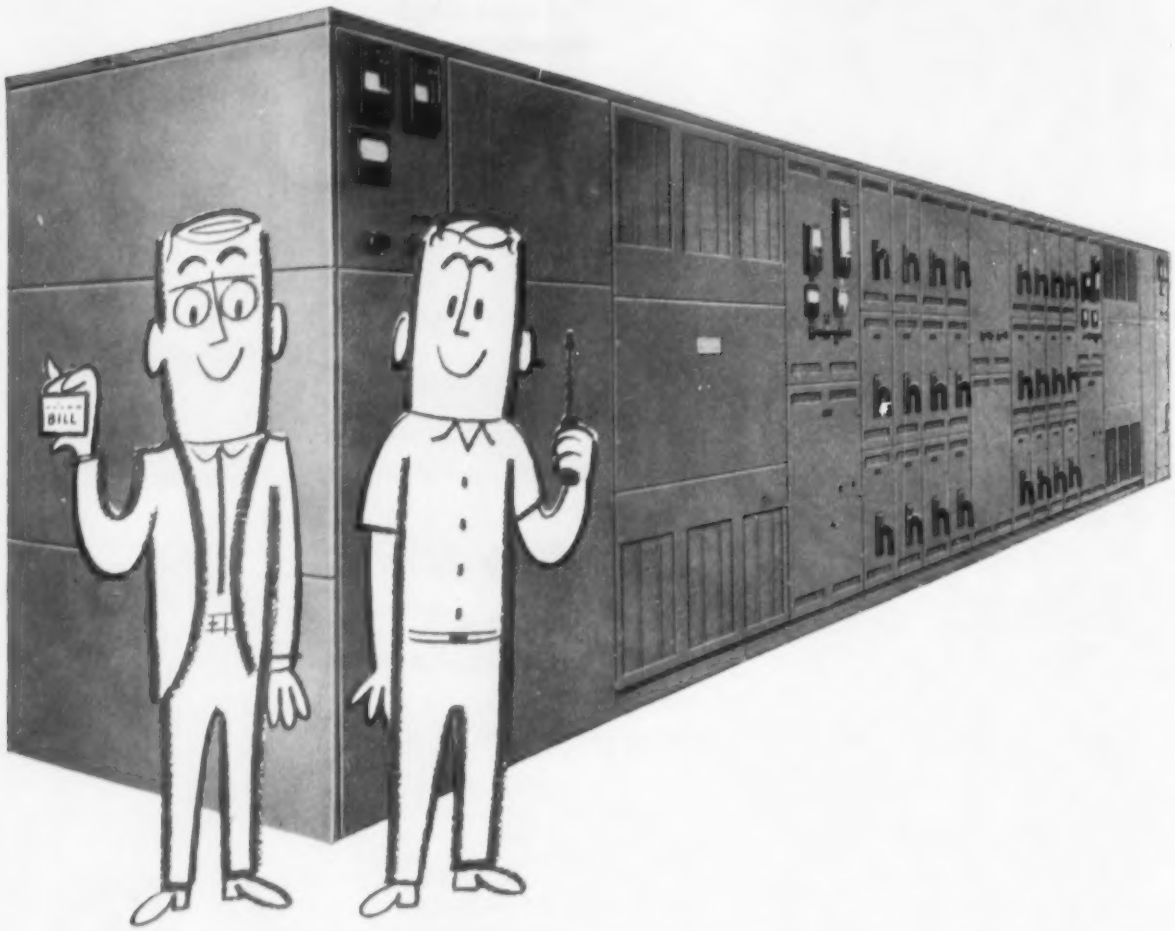
WRITE FOR
BULLETIN WPH-54
FOR COMPLETE DETAILS.

THE THOMPSON METHOD of luminaire maintenance . . . both feet on the ground and both hands on the job.

T-E THE THOMPSON ELECTRIC CO.

6686-TE 1157 Power Avenue • Cleveland 14, Ohio

I-T-E Secondary Unit Substations



. . . designed and built for economy in installation and operation

I-T-E Secondary Unit Substations bring electric power nearer to where you use it—make it more dependable—save you time and money.
They do it in several ways:

- By bringing higher voltages nearer the load and reducing power losses
- By reducing voltage drops inherent in long low-voltage runs and increasing machine efficiency
- By saving space—all necessary components are housed in one functionally designed unit
- By cutting delivery and installation time—units are assembled, tested and shipped ready for immediate installation from one source of supply
- By protecting plant personnel—all live parts are isolated and metal enclosed

I-T-E Secondary Unit Substations can be supplied for any application indoor or outdoor, and in any standard rating. For complete information, contact your nearest I-T-E sales office. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.

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I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Three-Wire Hookup Of Chronotherm

QUESTION A30—I have been told that a Chronotherm which usually requires 5 wires, three for the thermostat and two for the 24-volt clock motor, can be operated on three wires. How can it be wired on a 3-wire low-voltage cable and operate both clock and thermostat?—D.W.

ANSWER TO A30—Chronotherms come in three types referred to as series 10, 20, and 80. All are two position controls with some similarities, but each is designed for a different purpose. Series 10 is a timed two-position control for operating valves and relays; series 20 is a simple two-position control for operating motorized valves, motorized dampers, and relays; series 80 is a simple two-position control for operating valves, relays and small motors. Series 80 requires only two wires to the thermostat. Series 10 and 20 require three wires each to the thermostat. The three types are shown in the accompanying figure, each in a typical circuit.

Obviously the series 80 Chronotherm can be operated on three wires total, by running a neutral or common as the third wire, and by using the hot side of the thermostat as the other connection to the clock. Similarly by using only the W and B contacts of the series 10 Chronotherm (thus making a series 80 out of it) three wires will suffice to operate the clock and the thermostatic control. Similarly by using only the Blue and Red or the White and Red contacts of the series 20 Chronotherm, three wires will suffice.

Needless to say, the series 10 and 20 Chronotherms can not be wired with only three wires total and still have them retain their true operating functions. It can be done with four wires by using a common hot leg, but not by three wires.

The series 80 control is nothing but a thermostatic switch which opens and closes only one circuit much like a simple wall switch, only automatically as a function of rising and falling temperature. That is why it is referred to as a simple two-position control. It is popular for large-mass cast iron furnaces and for domestic heating boilers.

The series 20 control is similar to the series 80, but is required to operate devices such as motorized valves that are not arranged for spring-return-to-position, devices that have to be energized to open as well as energized to close.

The series 10 control is a very clever control with a built-in heater and is accordingly referred to as a heat-accelerating control. It offers a great advantage over a simple two-position control in that it greatly reduces the swings in the controlled temperature resulting from a large total lag.—J.S.

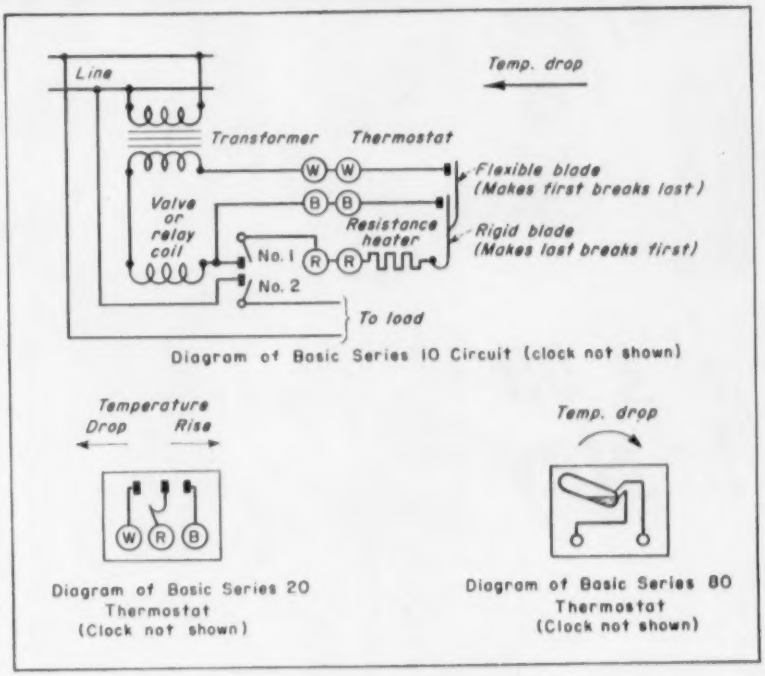

Diagram of Basic Series 10 Circuit (clock not shown)

Diagram of Basic Series 20 Thermostat (Clock not shown)

Diagram of Basic Series 80 Thermostat (Clock not shown)

Code Letters For Motors

QUESTION B30—What does the design letter and code letter on an alternating current motor tell and how important is it in the selection of a motor for particular application? Does a dc motor have a similar design and code marking? —W.E.G.

ANSWER TO B30—Polyphase squirrel-cage integral horsepower induction motors are classified in NEMA Standards Publication MG 1-1955 Motors and Generators under five design letters: A, B, C, D, and F, having different torque and current values.

A Design A motor is a squirrel-cage motor designed to withstand full-voltage starting which has normal starting current and normal starting torque. These designs are limited to services where it is imperative to have unusually low values of copper loss for efficiency or heating reasons. For example, in totally enclosed fan-cooled motors, cost and application reasons make it desirable to keep the same frame size as for open motors of the same ratings. To accomplish this it is sometimes necessary to use a reduced number of stator winding turns, thus obtaining a lower resistance at the expense of a lower reactance and, therefore a high starting current.

Design B motors are similar to Design A except they have low starting current with normal starting torque.

Design C motors have low starting current and high starting

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The Blackhawk snap strap snaps tighter . . . really holds its grip. That's because of the "hold bump" at the open end of the bracket. Ribbed bracket adds to the snap, provides rigid contact support of the conduit. Resists slips.

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torque. These motors are designed with double squirrel cages or equivalent rotor constructions and are used for applications requiring high breakaway torque or rapid acceleration.

Design D motors have low starting current, high torque, and high slip. These motors have high-resistance rotor windings and are used for loads having high inertia or requiring frequent starting or reversing. They are also useful for driving intermittent loads such as punch presses, where the stored energy in a flywheel supplies part of the torque peaks.

Design F motors have locked rotor torques of 125 percent and breakdown torques of 135 percent of their rated values with a locked rotor current of only 9 amps, per horsepower at 220 volts. These have very limited applications.

Single-phase integral horsepower motors are classified in NEMA Standards Publication MG 1-1955 Motors and Generators under two design letters: L and M having different torque and current values, each being designed for full voltage starting.

The nameplate of every alternating current motor, except a polyphase wound-rotor motor rated 1/20 horsepower and larger, is marked with the caption "Code" followed by a letter to show the locked rotor kva per horsepower. The letter designations for locked rotor kva per horsepower as measured at full voltage and rated frequency are as follows:

Letter Designation	*Kva per Horsepower*
A	0- 3.15
B	3.15- 3.55
C	3.55- 4.0
D	4.0 - 4.5
E	4.5 - 5.0
F	5.0 - 5.6
G	5.6 - 6.3
H	6.3 - 7.1
J	7.1 - 8.0
K	8.0 - 9.0
L	9.0 -10.0
M	10.0 -11.2
N	11.2 -12.5
P	12.5 -14.0
R	14.0 -16.0
S	16.0 -18.0
T	18. -20.0
U	20.0 -22.4
V	22.4-and up

Locked rotor kva per horsepower range includes the lower figure up to but not including the higher figure; for example, 3.14 is designated by Code A and 3.15 by Code B.

Direct current motors have no comparable design or code letter markings.—J.S.

ANSWER TO B30—The code letter indicates the locked rotor (or starting) kva per horsepower. A table in the NEMA motor standard and National Electrical code relate these letters to numerical values. Knowing these values, the voltage, number of phases and horsepower of the motor the starting current can be calculated. This starting current can of course be important both in the selection and protection of the motor.

The design letter is important in motor application since it indicates one or more of the following on polyphase motors—

(1) shape of speed-torque curve
(2) speed at rated load
(3) breakdown torque
(4) locked rotor torque
(5) locked rotor current

On single phase motors the design letter indicates the breakdown torque and locked rotor current.

There are no similar letters on dc motors, the above characteristics being largely determined by the type of windings: shunt, series, etc. —P.S.

Installation of Aerial Cable

QUESTION C30 — What special equipment is required to string self-supporting aerial cable for 2300-and 4160-volt overhead plant distribution lines? We use weatherproof and bare copper now with conventional crossarm construction, and hesitate to try cable for fear it will require special motorized equipment for installation because of its extra weight.—D.H.N.

ANSWER TO C30—The question can only be answered in a general way. No special equipment is required to string self-supporting aerial cable other than the standard items available in the overhead department of any utility for its construction work.

It is usual for cables of the voltage range indicated to have the insulated conductors covered with a metal sheath with an added protective armor. The sheath may be of lead and as now developed may be an aluminum alloy which is finding further application. No motorized special equipment may be required unless very large cables

She's reliable, available, and a perfect housekeeper...

THIS is the story of a queen of many kingdoms. A lady of quality, she is acclaimed as a wonderful business girl, the perfect housekeeper, and a perfect companion. Her romances are known to all of you, for they are the romances of your business kingdom.

Your business always appeared to this lovely queen as a kingdom, or a group of kingdoms. She found that the wire kingdom in every wholesaler's business so many times boasted of a king—and a powerful king, noted for his full lines and strength of character. But alas, there was no queen. No queen who could serve the kingdom in the absence of the king.

And so this lovely queen became proficient in the art of serving the king; always complimenting, never attempting to usurp the king's proper place. Her introductions throughout the land have resulted in the greatest of growing romances. She has added strength, character, and the reliability of profitable partnership. She is the true symbol of romance in the greatest era of the electrical wire and cable industry.

The queen of Diamond adds luster and wonderful harmony to your kingdom. She presents herself in courtly fashion. The symbols of her reign are desired by all your customers; wire and cable of brilliant blacks, Red-D reds, and immaculate whites. You know these as Diamond Flexible Cords; Type MD, Red-D-Prene; and DTX, the white Nonmetallic Sheathed Cable. Be sure you have a queen who's Red-D.

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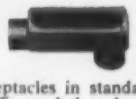
What's more, Ideal-Simplet fittings are delivered to you *fast!* And, field service help is available when needed. Our complete catalog describes every item we make — ask your wholesaler to show it to you. Listed are some of the more popular fittings. Look them over—*and ask for them by name on your next job . . .*

IDEAL SIMPLET CONDUIT FITTINGS

RECTANGULAR SIMPLETS



With covers and receptacles in standard hub styles and sizes. Tapered thread and no-thread. Popular L, LB, C, T, LL, LR, LRL and many others, including double-face and flange units.

FS AND FD SIMPLETS

Threaded and no-thread series. Single and gang units with device interchangeability feature. Covers include cast vapor tight types with cork or neoprene gaskets.

ROUND SIMPLETS

Includes G, GRF, GRLF, H, SE, SEH, P, PM, OS and OSL, etc. series, in variety of hub styles and sizes. Cast or steel covers with cork or neoprene gaskets. OSL and GRF types ideal for embedding in concrete!

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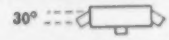
For universal application. Assorted sizes and styles including popular VW for masonry walls, VU for exposed systems, VO for mounting to sheet metal boxes. Same base with adapter makes changeover from 100-watt to 150 or 200-watt units. Long-lasting aluminum parts. Accessories and reflectors available.

HANGING DEVICES

Include the ALC for use with incandescent systems. Accessories, trigger hook lock assemblies, pendant loops, etc., available.

SIMPLET WEATHER-PROOF JUNCTION AND PULL BOXES



Used in subways, underpasses, etc. Type A with 4 hubs, type B with 4 hubs at convenient 30° down angle. Extension ring gives greater depth, fits smaller diameter devices.

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are installed. As a detail of comparable interest the questioner is referred to an advertisement in the March issue of E.C.&M. page 11 indicating current applications of self-supporting cable. This type of overhead construction has been greatly developed in the past ten years and much catalog information is available about it particularly among cable manufacturers.

Cables for higher voltage applications when erected without armor have developed troubles where the supporting clips have been similar to the construction used by telephone companies. This trouble has been due to the static and other voltage concentration between the clip and the insulation. This difficulty has been overcome by making the external cover either of a metallic conductor armor or similar material or metalizing the outer cable cover to make it sufficiently conductive to eliminate voltage concentration.

The use of a supporting messenger is needed to eliminate strain on the covering of the cable and permit stringing to be made easier.—C.O.D.

Can You ANSWER These QUESTIONS?

QUESTION P30—Would the power factor within an induction motor be improved by installing an extra winding for each phase and connecting the extra winding across a capacitor? Would this be a better way than just improving the power factor of the wiring to the induction motor?—E.B.

QUESTION Q30—In choosing capacitors for a plant, would there be any advantage in having higher voltage capacitors to serve the entire plant, or would it be advantageous to use the lower voltage type, so that they could be applied to the motors with low power factor?—E.S.H.

QUESTION R30—If three 50 kva single phase transformers connected in delta are being used for power and we wish to connect a single phase 20 kva lighting load with a mid-tap on one of the phases, how is the load distributed over the three phases?—V.M.M.

QUESTION S30—How can I make a burnout proof voltmeter by using transistors?—H.S.

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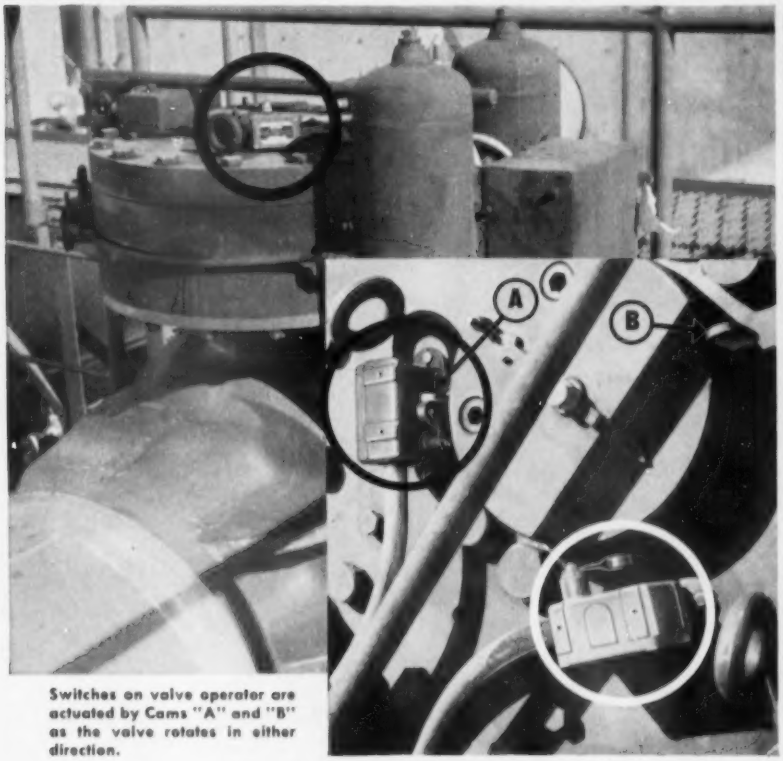


Switches on valve operator are actuated by Cams "A" and "B" as the valve rotates in either direction.

Explosion-proof switches provide automatic control on valve operator

MICRO SWITCH explosion-proof switches were installed on the gas valve operator by the engineer of a Texas gas company to provide safe and automatic control.

Two switches were placed so that they may be operated by cams as the valve rotates in either direction. The switches control the gas supply and turn on indicating lights when the valve is turned to either extreme position by the pressure of natural gas which it contains. The valve-operator is electrically controlled but is powered by gas.

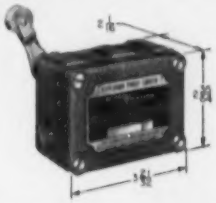
Double-pole, double-throw switches are used because each switch is required to perform two functions. When the valve reaches either limit, one of the switches is actuated to open or shut off the supply of gas and turn on a light on the control panel, which shows the position of the valve.

Explosion-proof switches are used to insure that no escaping gas will be ignited when electrical contact is made.

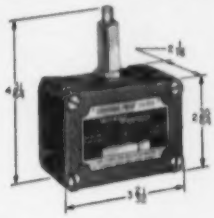
This installation is typical of thousands of such uses, which plant operating men, plant engineers, and maintenance superintendents are making of MICRO precision switches on present plant equipment. Production is increased by making machinery more automatic. Both operators and machines are protected when switches are used to prevent premature operation of equipment.

MICRO SWITCH Explosion-proof Switches (EX Series)

MICRO SWITCH "EX" Series of explosion-proof switches are listed by Underwriters' Laboratories for use in hazardous atmospheres of Class I, Group C (ethyl ether vapor) and Group D (gasoline, petroleum naphtha, alcohols, acetone, lacquer solvent vapors and natural gas); Class II, Group E (metal dust), Group F (carbon black, coal or coke dust), and Group G (grain dust)



This switch, which is shown in action in the gas company installation, is designed for cam or slide operation. The actuator arm is operated by clockwise rotation and is adjustable through 360°. Standard contact arrangement is single-pole, double-throw.



This push-rod plunger switch is designed for use as a limit switch on in-line motion applications. A stop ring near the plunger tip limits the over-travel and permits a steady load of as much as 100 pounds on the plunger without injury to the enclosed precision switch. Standard contact arrangement is single-pole, double-throw.

ELECTRICAL RATINGS

15 amperes 125, 250 or 460 volts a-c; ½ ampere 125 volts d-c; ¼ ampere 250 volts d-c.

Other explosion-proof switches in the MICRO "EX" Series include a cross roller lever switch for use where the operating mechanism approaches from a direction perpendicular to the longitudinal axis of the switch. The switch is also available with a large paddle-shaped actuator for manual control of power equipment.

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Questions on the Code

Answered by

B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.
GLENN ROWELL, Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.
B. Z. SEGALL, Consulting Electrical Engineer, New Orleans, La.

Service Grounding Requirements

Q. *I have noticed a tendency on the part of some contractors to become slightly "Ground Bushing Happy", in order to eliminate the prospect of receiving an inspection item. One job which I noticed particularly had ground bushings on the conduit bringing in the ground wire, the service conduit, (although the last knockout had been removed) and both ends of a nipple connecting the water heater switch and service cabinet.*

In order to clarify this grounding problem in my mind please correct me if I am wrong in the following assumptions.

1—The only purpose of the conduit carrying the ground wire is to protect the ground conductor from damage.

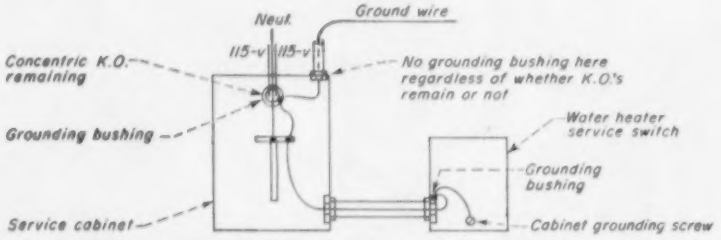
2—The ground wire must ground the neutral conductor, the service conduit and the service cabinet; grounding bushings are not needed if all conduit is made tight to the cabinet with approved EMT fittings; no thread rigid fittings or lock nuts and bushings and no concentric knockouts remain where these conduit enter the cabinet.

3—Would the Code be met if the No. 8 ground wire (60-amp service) was installed according to sketch No. 3?

4—Would the following be correct?

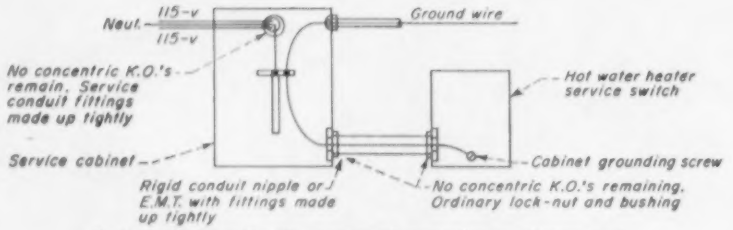
a.—A 100-amp service is run with two No. 2 RH and a bare No. 4. A No. 8 ground wire would be satisfactory.

b.—A 100-amp service with two No. 1 R and a bare No. 4. A No. 6 ground wire is now required.—J.M.H.



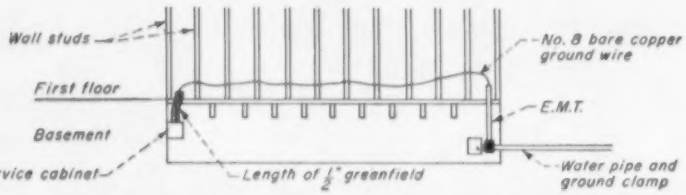
Ques. No. 1. Does the above meet all grounding requirements of the N.E. Code?

Fig. No. 1


Neut.
115-v
115-v
Ground wire
No concentric K.O.'s remain. Service conduit fittings made up tightly
Hot water heater service switch
Service cabinet
Cabinet grounding screw
Rigid conduit nipple or E.M.T. with fittings made up tightly
No concentric K.O.'s remaining. Ordinary lock-nut and bushing

Ques. No. 2. Does the above meet all grounding requirements of the N.E. Code?

Fig. No. 2



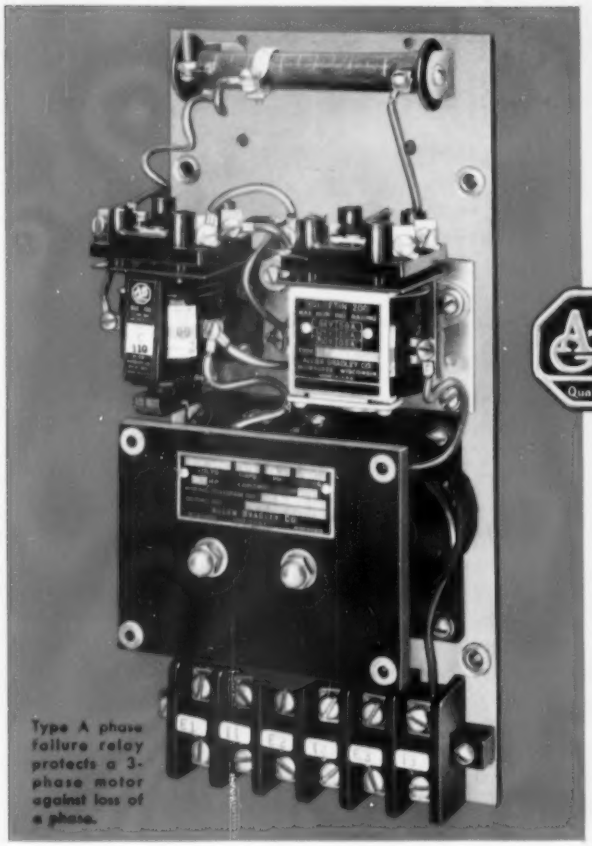
Ques. No. 3. Would the above meet Code requirements? Assuming the No. 8 ground wire to be run within a finished wall.

Fig. No. 3

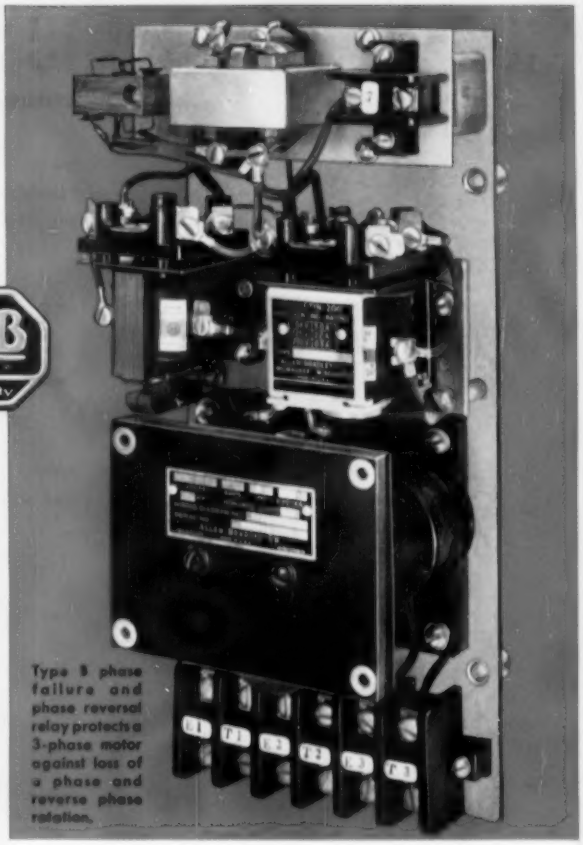
A. In reply to your specific questions I wish to comment as follows:

1—According to Section 2592 a common grounding conductor may or may not require protection from mechanical injury depending upon its size and the general conditions of use. When the conditions indicate that the grounding conductor will be subject to mechanical injury it must be protected by conduit, tubing or cable armor and as you say when conduit is used in such cases its purpose is to protect the ground conductor from damage.

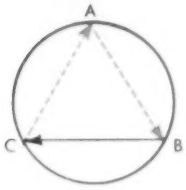
It is significant to note however that this same rule requires "metallic enclosures for grounding conductors shall be continuous from the point of attachment to cabinets or equipment to the grounding electrode, and shall be securely fastened to the ground clamp or fitting." In order to satisfy this requirement the conduit is connected to the service equipment by means of a lock nut and bushing and is run continuous to an approved threaded ground fiitting which is clamped to the grounding electrode. With this arrangement we have two parallel paths to ground, one over the copper conductor and the other over the conduit. In the case of a heavy fault coupled with a loose connection in the conductor circuit, the conduit should be able to clear the fault without arcing at its terminal points. It therefore would be essential to install a grounding bushing where the conduit terminates at the service equipment. If the conduit was not continuous to the grounding electrode and did not assure a low impedance path to



Type A phase failure relay protects a 3-phase motor against loss of a phase.

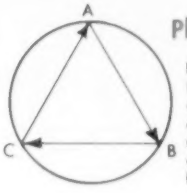


Type B phase failure and phase reversal relay protects a 3-phase motor against loss of a phase and reverse phase rotation.



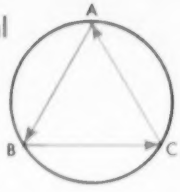
Phase Failure

This relay is sensitive to current in all lines to the 3-phase motor. If one current fails or becomes much less than current in other 2 lines, relay opens control circuit. Protects motor against failure of a phase on primary side of distribution transformer supplying motor, even tho it has wye-delta windings.



Phase Reversal

In addition to phase failure, this relay detects phase sequence and opens motor control circuit when a phase has been reversed.



RELIABLE PHASE FAILURE OR PHASE REVERSAL PROTECTION

The Bulletin 812 Type A phase failure relay is a static device which compares the currents in each of the three lines supplying a motor from a 3-phase system. In case the current in one line fails or becomes much less than that in the other two lines, the relay operates to open the control circuit to the starter which disconnects the motor from the line and prevents it from running single phase.

Both the Bulletin 812 Type A and Type B relays operate over a wide range of current, and thus coils do not have to be accurately selected for the precise current being drawn by the motor. These relays will function accurately for currents from no load to locked rotor.

The control circuit contacts are opened in three or four cycles after a phase failure occurs, and thus the relay can be used to protect against the failure of a motor to reverse. In the event of a single phase or of a phase failure, the Bulletin 812 relays will operate dependably because the construction does not include frail or moving parts, especially in the sensitive portion of the system. There are no delicate parts to get out of adjustment, or bearings which might stick and cause faulty operation.

The Bulletin 812 relays are built in only four sizes and will reliably protect motors with full load currents from 1.25 amperes to 300 amperes against phase failure and phase reversal. Let us send you more detailed information about this up-to-date answer to phase failure and phase reversal problems!

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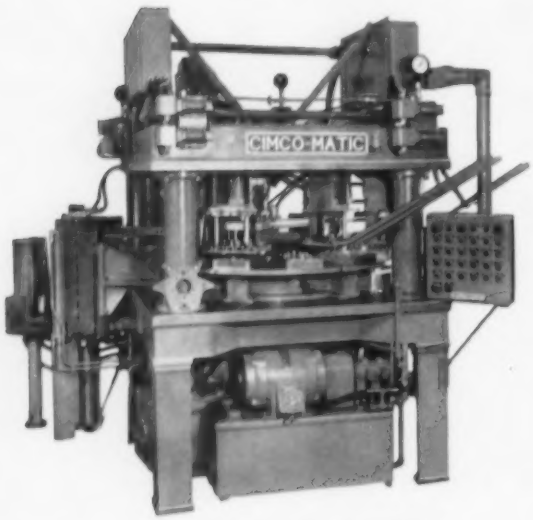
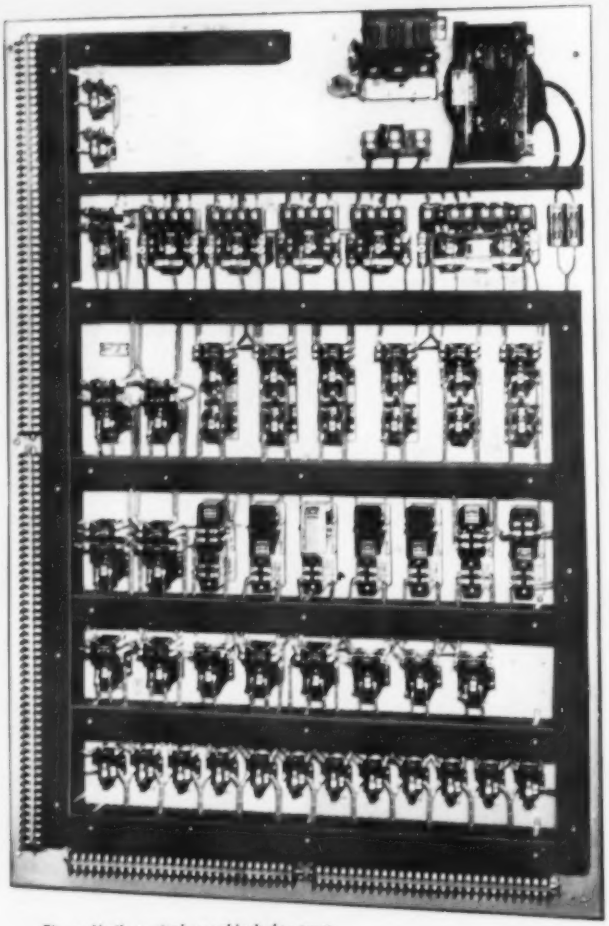


Cimco-Matic machine for automatically assembling Chrysler inner brake plates.

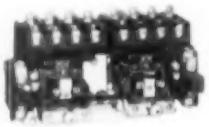


Cimco-Matic control panel includes over 40 A-B starters, relays, timers, etc.

Some Allen-Bradley control items—universally recognized for trouble free operation

Bul. 709 Size 7 solenoid starter for 300 hp, 220 v; 600 hp, 440-550 v motors.

Bul. 709 Size 1 solenoid starter for 5 hp, 220 v; 7½ hp, 440-550 v motors.



Bul. 705 Size 1 reversing switch with switches electrically and mechanically interlocked. Available in 9 sizes for motors up to 300 hp, 220 v; 600 hp, 440-550 v.

Bul. 704 Size 1 hum-free contactor with magnetic latch.

Bul. 702 Size 2, 50 ampere solenoid contactor.

Bul. 700 Type C solenoid relay, rated 10 amp. 600 v, max.

Bul. 700 BX, 4 pole universal relay with N.O. & N.C. contacts.

Bul. 800T oiltight operating units for machine tool service. They are available in many handy forms.

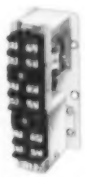
Bul. 800T 5 button pendent station.

Bul. 800T oiltight control station for machine tool service.

Bul. 894 disconnect with visible contacts for combination starters and control panels.

Bul. 806 rotary pilot switch, 15 & 25 amp. 600 v.

Bul. 802T adjustable lever oiltight limit switch.



Bul. 849 timers available in wide variety of types. Adjustable from 1/6 sec. to 3 min.

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6-56-MR

ground, a severe hazard could exist.

As an example the short section of conduit could be accidentally grounded to a steam, gas, water or other metal object and when a fault occurred an arcing path to ground would be established which easily could promote a fire, and the condition would be aggravated if the grounding conductor were bare.

2—A common grounding conductor, see Section 2553, is one which grounds not only the system grounded conductor but also the service equipment and other metal raceways or enclosures beyond the service equipment. In order to assure continuity at the service equipment one of the means provided by Section 2572 must be satisfied. Section 2572-b recognizes threaded couplings and threaded bosses on enclosures when rigid conduit is involved. Section 2572-c recognizes threadless couplings made up tight for rigid conduit and electrical metallic tubing and when the connection to the box is by a threaded boss the rule is satisfied. When no threaded hubs are used, it is then necessary to use a grounding bushing to assure continuity. Such a grounding bushing may be used on EMT by substituting it for the lock nut of the box connector. In other words the Code recognizes the connection provided by the use of a threadless coupling, but when such fittings are connected to enclosures by the use of a lock nut and bushing one of the two grounding type of bushings must be used. Abbott's National Electrical Code Handbook clearly covers this opinion.

In connection with your illustration covered by Fig. No. 1, I believe the Code requires a grounding bushing on the conduit protecting the grounding conductor. I also believe there should be a grounding bushing on both ends of the nipple connecting the service cabinet to the service switch. In support of this opinion, assume that the live conductor became grounded on the ordinary bushing in the service cabinet. A parallel path to ground is established through loose locknuts, bushings and concentric knocknuts which, in the case of a service fault with no overcurrent device outside of a primary fuse, is bound to create sparks and arcs.

In connection with Fig. No. 2, which shows no grounding bushings at any points of conduit connection to boxes, I do not hesitate to say that this is entirely incorrect and does not satisfy the Code

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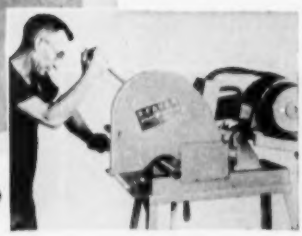

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Cutting Time Chart—for No. 14 and No. 20

(Most users report less cutting time than shown).

SIZE	MATERIAL	CUTTING TIME
2 Inch	Steel Pipe	5 Seconds
4 Inch	Cast Iron Soil Pipe	6 Seconds
6 Inch	Steel Pipe	40 Seconds
2 Inch	Cold Rolled Steel	20 Seconds
4 x 4 x 3/8 Inch	Steel Angle	12 Seconds
4 Inch	Steel Channel	10 Seconds
2 Inch	Galvanized Pipe	5 Seconds

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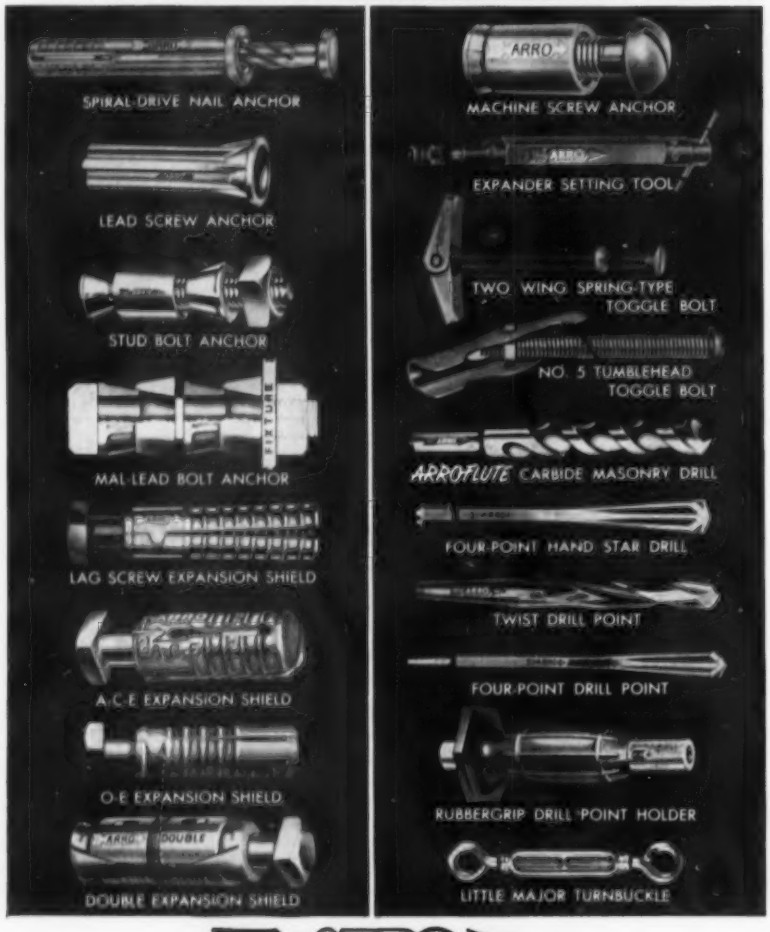

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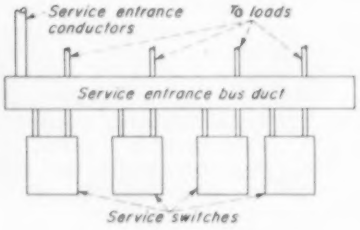
requirements. Assume that the live conductor becomes grounded on the bushing at either end of the conduit connecting the boxes. In order to complete the path to ground the ground current, which on unfused service conductors usually is considerable, must pass through the loose connections provided by ordinary lock nut and bushing connections.

In connection with Fig. No. 3, Section 2592 requires that metallic enclosures for grounding conductors shall be continuous from the point of attachment to cabinets or equipment to the grounding electrode. On the basis of this provision it appears that this procedure would not satisfy the Code. While the Code does not specifically cover the following point, it appears to me that a grounding conductor, which according to Section 2511 safeguards the hazards presented by lightning, high voltages etc., should follow the most direct and shortest path to the grounding electrode. We should endeavor to make it as short as possible, so that when lightning strikes or high voltages enter, the path to ground will expose as little of the building as is practically possible.

In reply to your fourth question, Section 2594 covers the size of the common grounding conductor for various sizes of services. A No. 2 service conductor with a bare No. 4 ground wire could be grounded with a No. 8 grounding conductor. A No. 1 service conductor with a bare No. 4 ground wire could be grounded with a No. 6 grounding conductor.—B.A.McD.

Service Wiring

Q. *Can electricians bring load wires back through the bus duct?—O.P.J.*



A. No! Section 2306 is quite explicit and states: "Conductors other than service conductors, grounding conductors, or control conductors from time switches having overcurrent pro-

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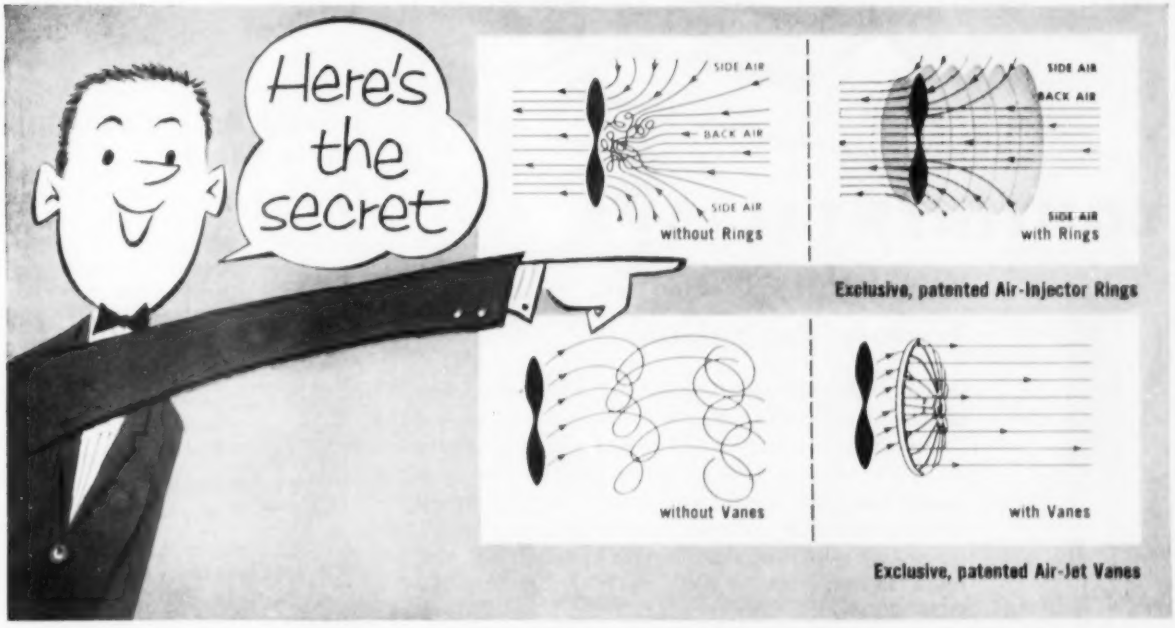

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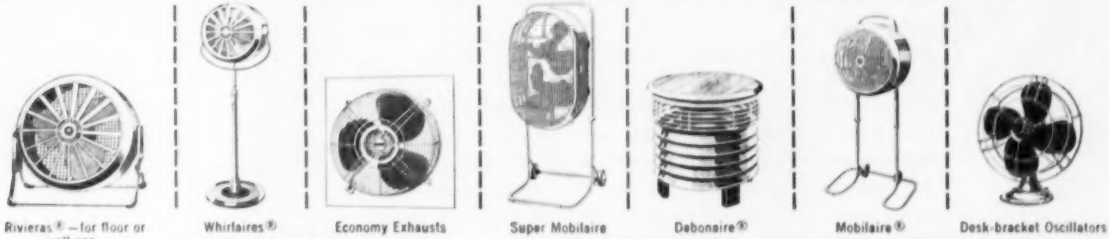

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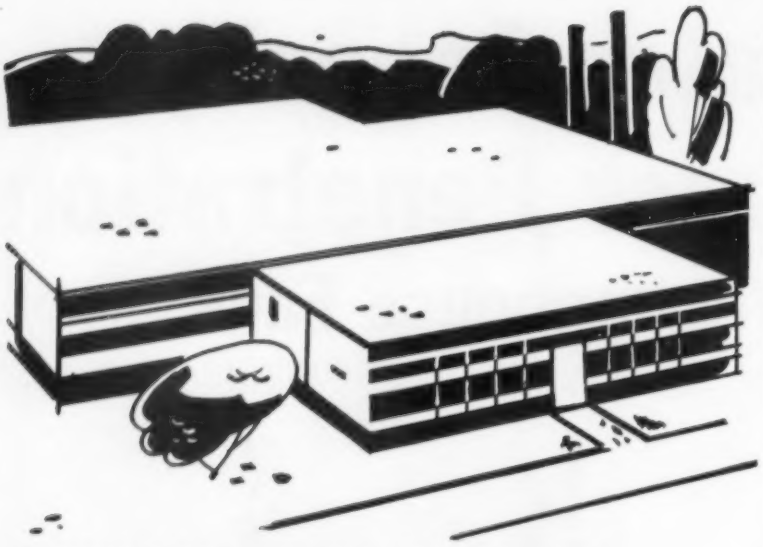

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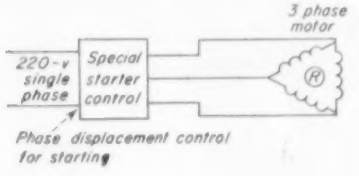
tection, shall not be installed in the service raceway."

It is possible to run the load conduits, without break, through the service raceway and thus comply with this rule. However, since it would be cheaper and more feasible to rearrange the construction so as to permit direct feeds to the switches, I cannot see where we gain anything from the construction shown in the diagram. Using bus duct, I doubt whether or not sufficient space is available for permitting the passage of these load conduits over or under the busses. —B.Z.S.

3-Phase Motor Operating Single Phase

Q. *If a 3-phase, 220-volt, delta S. C. motor is operated on single phase 220 volts with special starter control, will the motor develop 58% of its 3-phase hp or 50%? See diagram.—P.P.G.*



A. A 3-phase induction motor, once started and running at full speed, will operate single phase and deliver about 60% of its rated capacity with the same slip and temperature rise as when connected 3-phase. In other words a 3-phase motor operating single phase takes 73% more current from the circuit conductors, when carrying the same load. The maximum pull out torque will be approximately one-half of normal.—B.A.McD.

Exit Lights

Q. *What determines the LOCATION of "Exit" light fixtures in commercial buildings? What are "Exit" light fixture requirements and recommendations? —Z.B.*

A. Actually all these questions are not directly Code problems. The Code says, basically, that if "Exit" lights are required then they shall be installed as required by Article 700.

As a rule, the "Exit" lights are required by a local ordinance, or

Is emergency lighting required by law in your locality ?

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law, a general building Code, etc. The National Electrical Codes does not require them.

There is a "National Building Code" recommended by the National Board of Fire Underwriters. Among other things this code sets up recommendations for the total number of exits that should be supplied for various types of buildings. It also provides for proper hall spaces. Then it sets forth how these exits and halls should be kept adequately lighted at all times that the building served thereby is occupied.

Various municipalities adopt these recommendations by local ordinances, laws, etc., and add to them by requiring specific lighting—such as two lights, or 15-watt or 10-watt, etc., lamps, or a minimum footcandle base, etc.—and other specific requirements which attempt to fix the number and type of "Exit" and "Emergency" lighting units.—B.Z.S.

Insulated Neutral Bar

Q. *Why is an insulated neutral bar required on an automatic transfer panel?—R.W.F.*

A. I suppose you refer to the automatic transfer switch that is used for emergency systems as required by Article 700.

If an insulated neutral bar were not required you would, in effect, tie in the neutral to the metallic non-current carrying parts of the system, i.e., the automatic transfer switch metal cabinet, etc. The code permits such tie in only at the service entrance and I assume that this grounding was so accomplished at the service entrances in question. Therefore, the neutral bar in the transfer switch must be insulated to keep from making a second such grounding of the neutral conductor, beyond the service entrance.—B.Z.S.

Fixture Splices

Q. *If a lighting manufacturer solders the wire and tapes it, is that satisfactory? Refer to Standard for Electrical Lighting Fixtures by UL, page 30, paragraph 157.—R.A.P.*

A. Yes, this standard does recognize this construction. —B.Z.S.

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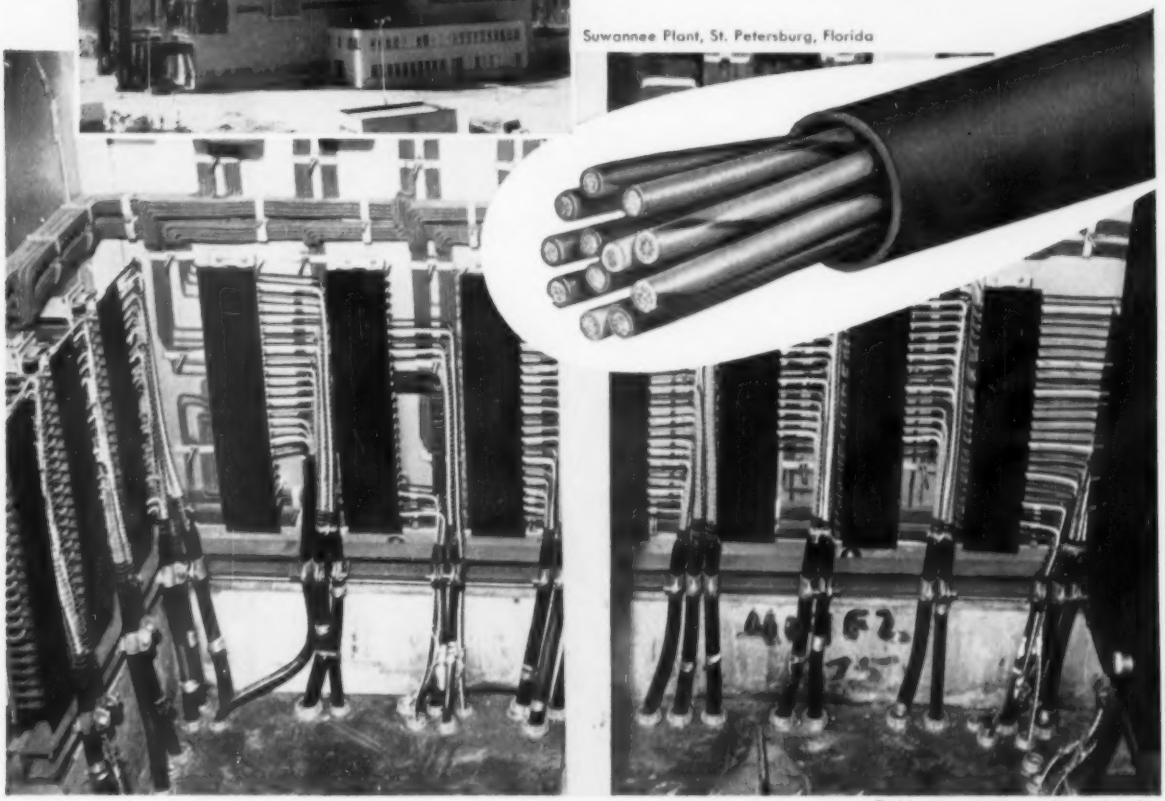

Turbine board, Higgins Plant, Unit #2

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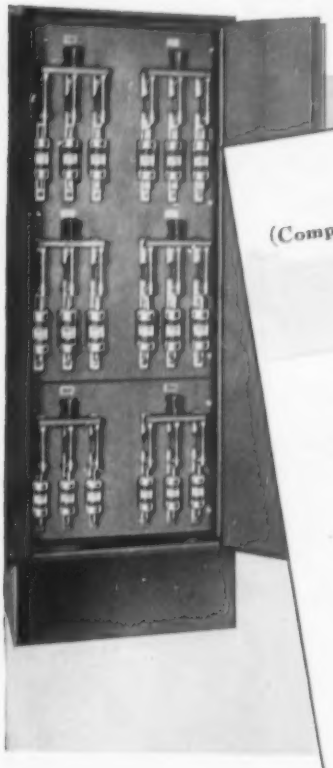

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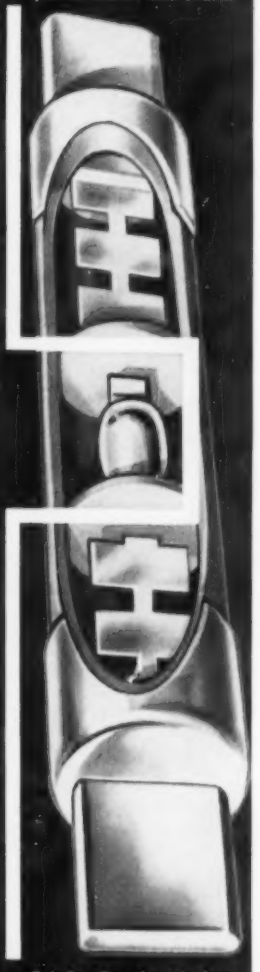

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In The News

NISA Holds National Convention in Philadelphia

Annual 4-day meeting, attended by 1345 delegates, presented 65 industry leaders on program. Charles J. Covington of Mount Vernon, Illinois, elected president for coming year. Convention theme linked technical know-how with practical economics and sales promotion.

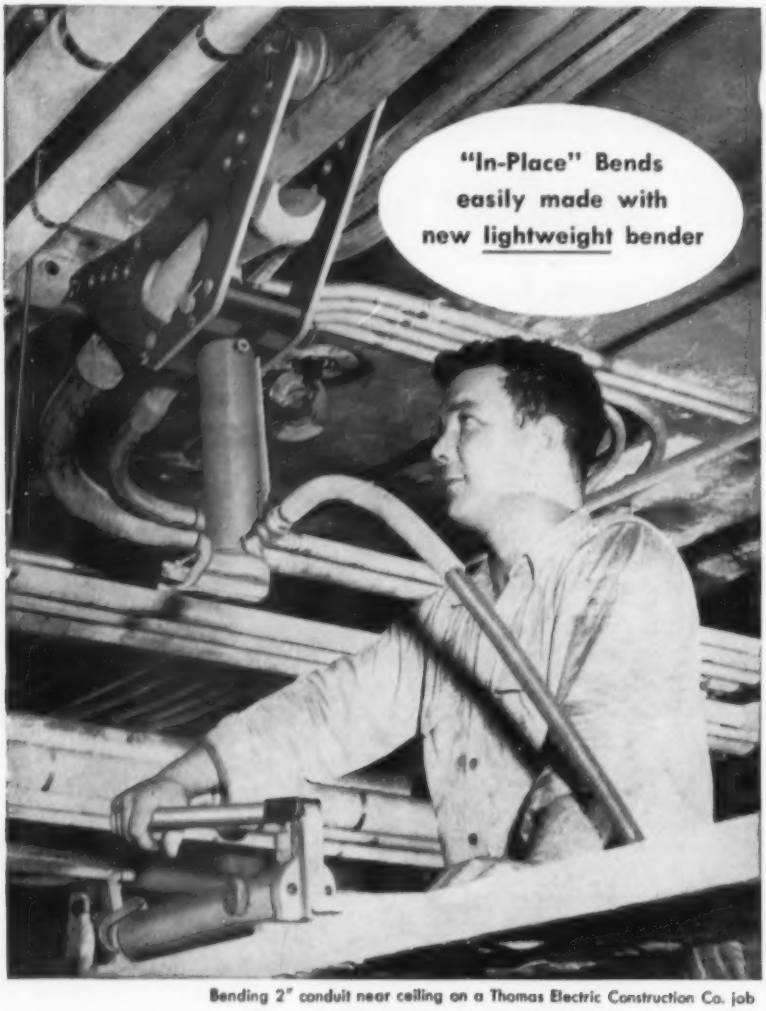
"How to wind it, cost it and sell it"—the triple-objective theme of NISA's 23rd annual convention—proved to be a subject that captured the sincere interest of 1345 delegates who attended the Association's 4-day conclave in Philadelphia last month. Analyzing basic repair techniques, economics, management and salesmanship, the theme provided discussion material for 11 forums scattered through the afternoons of May 14-16, with answers being furnished or parried by a total of 54 panelists representing not only the motor service industry, but the fields of manufacturing and research as well. Questions raised by delegates were searching ones, covering such basic considerations as profit margins and distribution practices, advertising and shop records, characteristics of various insulations, aluminum vs copper for magnet wire, use of silicones and epoxy resins, glass and asbestos products, dynamic balancing of rotating equipment, and intelligent depreciation and amortization of shop equipment. These questions—literally running into the hundreds—also referred to coating practices, overhead and hidden costs, management of small vs large repair organizations, motor and transformer winding data, and sale of new vs rebuilt equipment. That these forums were helpful and thought-provoking was clearly evidenced by capacity attendances and prolonged discussions which were stimulated.

Future Growth Predicted

Keynote for the convention was defined at the opening general session by H. F. McCullough, general manager of the service shop department for the General Electric Company. Discussing the growth and importance of the motor service industry, he mentioned that, contrary to any shadow of a slowdown, the electrical industry as a whole is surging forward, impelled by an expanding population, rising standards of living and rapidly multiplying technology. This progress will no doubt double the business of the electrical service field within a decade, he said, although the working population will rise only 14% during that same period. This indicates a tight labor problem which can be solved only through innovations in tooling and

NATIONAL OFFICERS OF NISA for the coming season, elected at the Philadelphia convention, are (l to r) Frank W. Ross, Ross Electric Motor Shop, Fairmont, Minn., treasurer; Alfred Elson, Jr., New England Machine & Electric Co., Pawtucket, R. I., vice president; Charles J. Covington, Dowzer Electric Machinery Works, Mount Vernon, Ill., president, and Paul M. Sievert, Sievert Electric Co., Chicago, Ill., secretary.

INCOMING DIRECTORS FOR NISA (seated) include Joseph F. Dudley, Dudley Electric Works, Flint, Mich.; Alex A. Shovan, Industrial Electric Service Co., Hawthorne, N. J.; J. Arthur Turner, Jr., Tampa Armature Works, Inc., Tampa, Fla.; and Frank W. Sloan, San Diego, Cal. Pictured backing them up are outgoing directors W. W. Saunders, Lenawee Electric Co., Adrian, Mich.; H. Q. Griffith, Belyea Co., Inc., Jersey City, N. J.; G. E. Jones, G. E. Jones Electric Co., Amarillo, Tex.; H. A. Lilly, Tampa Armature Works, Inc., Tampa, Fla., and William M. Hogue, Larson-Hogue Electric Co., Los Angeles, Cal.



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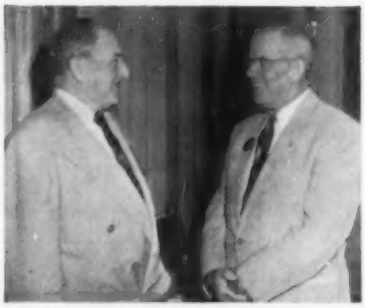

G. E. Jones, G. E. Jones Electric Co., Inc., Amarillo, Tex., and W. S. Giles, Giles Armature and Electric Works, Inc., Marion, Ill.

methods, plant layouts and new equipment, increased skills and more efficient management. He also mentioned the trend to automation, stressing the importance of maintenance, continuous process operations and potential losses in the event of equipment breakdown. The growing importance of electrification was illustrated by citing the 1945 average of approximately 2 kwhrs per industrial man-hour, whereas today's average is now 5 and the 1964 estimate will possibly exceed 10 kwhr per man-hour. In conclusion, McCullough urged the industry to realistically consider the future and to prepare now for the increased responsibility and opportunity which that future holds.

Eight Technical Papers

In addition to McCullough's challenging address, the three general morning sessions included eight technical papers, four of which covered shop methods and practices, with the remaining four covering management, promotion and economics.

In the first classification, G. E. Jones of the G. E. Jones Electric Co., Amarillo, Texas, discussed "Interspersed Winding"—"a freak connection which picks up one coil in each adjacent group and connects with the phase pole group under consideration . . . resulting in the mechanical advantage of a shorter span while also giving a better distribution factor."

"Coil Making Efficiency" was the subject of an analysis of C. Arthur Phares of the Southwest Electric Co., Oklahoma City, Okla., who stressed the fact that production costs can only be kept to a minimum by having trained personnel, proper equipment and materials, efficient shop procedures, accurate cost records and motor data cards, each of which factors he illustrated by citing examples

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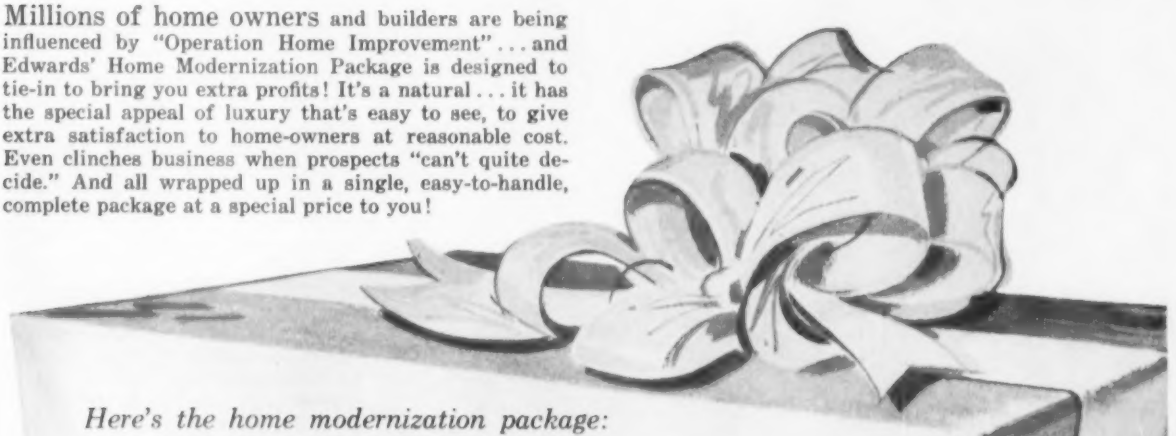

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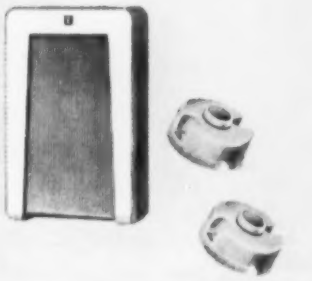

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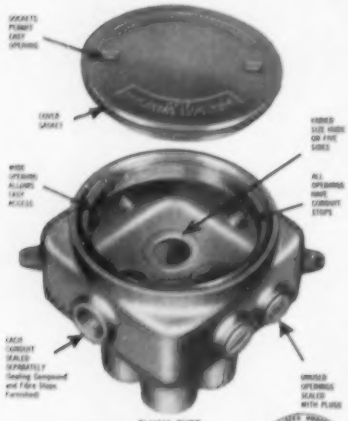
- REDUCED COSTS
- EACH CONDUIT SEALED SEPARATELY INSIDE THE BOX.

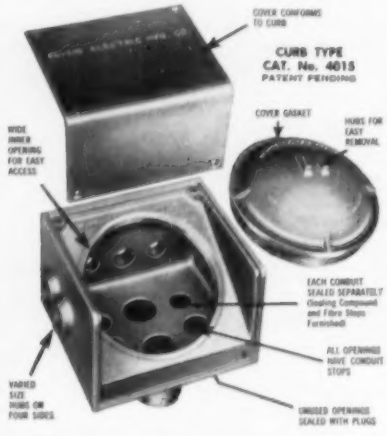


FLUSH TYPE
CAT. No. 4016
PATENT PENDING

These boxes have been designed for installation in hazardous locations in compliance with the National Electrical Code. They provide protection against damage caused by explosive vapors or gases creeping through conduits to switches inside a building or other electrical equipment.

Each conduit run is sealed separately inside the box. The Flush type Box can be mounted into any flat surface (floors or walls). The Curb type Box may be mounted in outside corners of columns or curbs. Ample wiring space is provided and changes can be made in a circuit at any time without disturbing the others. Both types have hubs of varying sizes on sides and bottom. An outstanding Revere development that simplifies wiring, affords better protection and cuts down installation costs.

Schematic drawing illustrates the application of Revere Explosion-Proof Sealing Junction Boxes from Gasoline Station building curb to dispensing pumps or islands. Wiring is simplified and safety results.


COVER CONFORMS TO CURB
CURB TYPE
CAT. No. 4015
PATENT PENDING
COVER GASKET
HUBS FOR EASY REMOVAL
WIDE INNER OPENING FOR EASY ACCESS
EACH CONDUIT SEALED SEPARATELY Sealing Compound and Fibre Stops Furnished
ALL OPENINGS HAVE CONDUIT STOPS
VARIED SIZE HUBS ON FOUR SIDES
UNUSED OPENINGS SEALED WITH PLUGS

Note: A descriptive circular will be sent free upon request.

REVERE ELECTRIC MANUFACTURING CO. • 6009-17 BROADWAY • CHICAGO 40, ILL.

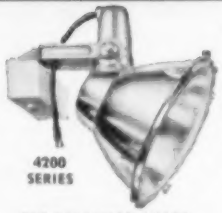
Available in Canada thru Curtis Lighting, Ltd. • Leaside, Toronto, Ontario

THE ONLY COMPLETE LINE OF LUMINAIRES - FLOODLIGHTS AND POLES FOR STREET - SPORTS AIRPORT - SERVICE STATION - OUTDOOR THEATRE - MARINE AND INDUSTRIAL LIGHTING

Revere ELECTRIC MFG. CO. CHICAGO, ILL.

HAS THE CORRECT TYPE OF FLOOD, LUMINAIRE OR POLE for EVERY INSTALLATION NEED

When you standardize on Revere Units you can be sure you are getting the finest in design, construction and performance.



4200 SERIES
750-1000-1500 WATT ENCLOSED FLOODS

3800 SERIES
FAMOUS ELIPTOR 300 TO 1500 WATT

AREA LIGHT
MERCURY • INCANDESCENT

STREET LIGHTING LUMINAIRES

John J. Reddington, J. J. Reddington Electric Service Co., and Fred Ferris, Northeastern Electric Co., Boston, Mass.

from his own shop experience.

Michael E. Assalone of the Florida Electric Motor Co., Miami, Fla., asked and answered the question, "What's The Story on Fractionals?", stating that, up through last year, the motor manufacturing industry had produced more than 500 million fractional-horsepower units. Of this total about 350 million are still in use, but their expected breakdown or obsolescence should exceed 20 million a year for the next decade. This potential repair and resale market should be worthy of considerable attention, he said, and he provided numerous illustrations to prove that "small motors make big business."

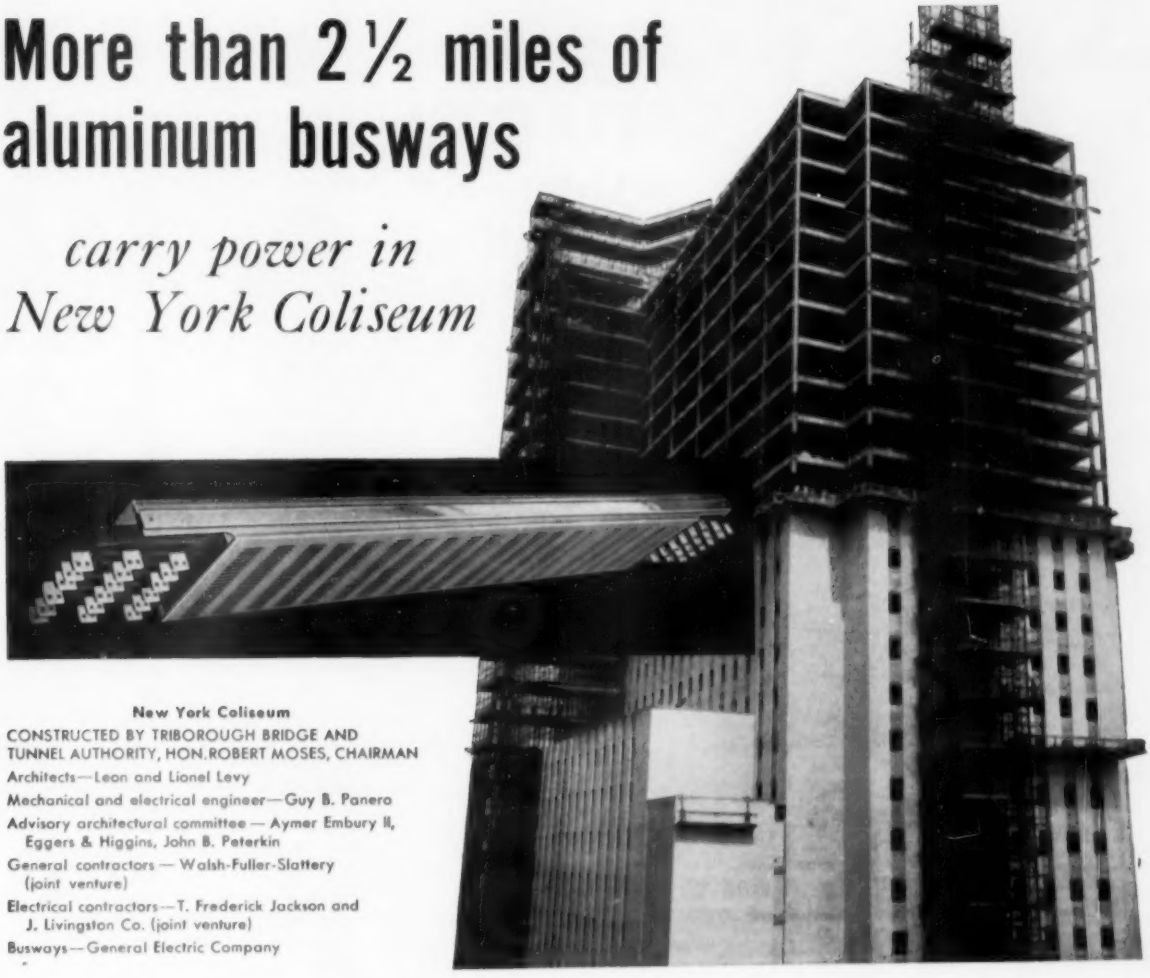
As the fourth of the repair-practice speakers, Ralph O. Kufen of the Kufen Electric Co., Hatboro, Pa., presented a blackboard-illustrated talk covering a "Practical Winding Formula for the Motor Repairman." Using a ¼-hp, 220-volt, 1800-rpm 3-phase motor stator as an example, he developed his thesis with sketches and formulas to prove that a knowledge of coil calculations would help test, wind and connect motors, reduce inventory, result in more intelligent application, promote sales and enhance company prestige.

Incentive Management Urged

Of outstanding interest was a discussion of "Incentive Management" by James F. Lincoln, chairman of the board of the Lincoln Electric Co., Cleveland, Ohio. Mentioning that "industry exists only as long as it can furnish the consumer with a better product at a lower price than the consumer can make it for himself", Mr. Lincoln went on to say that cooperation between labor and management was essential, and that it could be obtained only by boosting the workers' morale, introducing incentives so that every man is "re-

More than 2½ miles of aluminum busways

carry power in New York Coliseum



New York Coliseum
CONSTRUCTED BY TRIBOROUGH BRIDGE AND TUNNEL AUTHORITY, HON. ROBERT MOSES, CHAIRMAN
Architects—Leon and Lionel Levy
Mechanical and electrical engineer—Guy B. Panero
Advisory architectural committee—Aymer Embury II, Eggers & Higgins, John B. Peterkin
General contractors—Walsh-Fuller-Slattery (joint venture)
Electrical contractors—T. Frederick Jackson and J. Livingston Co. (joint venture)
Busways—General Electric Company

Important Innovations in Coliseum

New York City's new Coliseum is modern in every detail, particularly in its electrical distribution system. This 26-story office building, combined with 365,000 square feet of display space, has one of the first major installations of a higher voltage distribution system (480Y/277 volts). More than 2½ miles of busway incorporating aluminum conductors were used to feed power to this huge structure.

Higher Voltage System Saves Money

The higher voltage system provides greater capacity and flexibility than conventional systems. Yet it requires only half as many, or half as large, risers and feeders. Characteristics such as excessive voltage drop or costly power losses present no problems to this system. The use of lightweight aluminum bus bars makes the equipment easier to handle and easier to install.

More and more manufacturers of packaged electrical distribution systems are finding that Alcoa® Aluminum Bus Conductor offers advantages of lower cost, availability, design flexibility. Aluminum distribution bus weighs a third less than a copper system of equal conductivity. Pound for pound, it has greater current-carrying capacity than cable in conduit.

Alcoa Aluminum Is Your Best Bet, Too

Wherever your production requirements demand an efficient, flexible electrical distribution system, it will pay you to specify busways with Alcoa Aluminum Conductors. Write us for the names of manufacturers who specialize in this lighter, better, more economical product. Aluminum Company of America, 2302-F Alcoa Building, Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

New TRUCO diamond drilling machine

For High Speed Drilling anywhere in REINFORCED CONCRETE with bits to 14" O.D.

The new Truco Diamond Drilling Machine takes Truco diamond drill bits all the way up to a huge 14" O.D. bit (ideal in drilling for air conditioning ducts) as standard equipment. Three drill motors available for varying drilling conditions. Truco's exclusive 360° sweep, both vertically and horizontally, and vertical adjustment for wall drilling, make it very versatile. Completely portable and easily operated by one man. Fast, clean cutting and fine accuracy of the Truco unit (as compared to ordinary drilling techniques) can easily offset the entire investment in drill machine and diamond bits on its first job.

This core of reinforced concrete, 4¾" in diameter and 12" long, was drilled in just 12 minutes.

WHEEL TRUEING TOOL CO.

87-3200 W. Davison Avenue • Detroit 38, Michigan

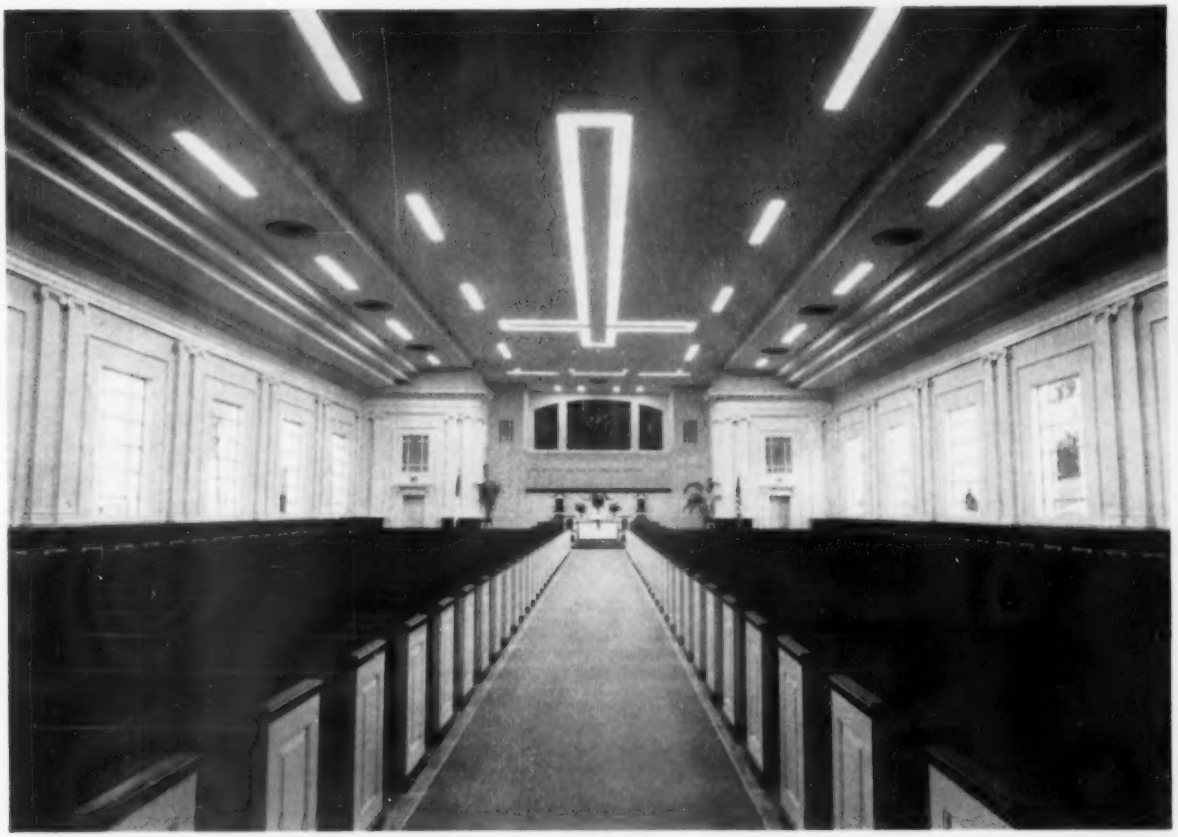
Cecil R. Medsker, Miller-Seldon Electric Co., Detroit, Mich., and Hector Roberge, H. Roberge, Inc., Montreal, Canada.

warded in accordance with his ability and contribution" to the success of the company he works for, and to develop the workers' abilities to their fullest potential. Providing that this approach is sound and practical, he mentioned that, since this incentive idea had been adopted by his own company 17 years ago, manhours had been reduced 92% per unit, the selling price of Lincoln welding equipment has been steadily downward, volume has steadily climbed, and the average income of every employee in the plant had more than doubled.

Also of interest was a 3-part marketing-promotion presentation by George D. Richardson, J. Franklin Mentzer and Gordon S. Thomas of Richardson, Thomas & Bushman, Inc., Philadelphia. Under the topic of "How To Add Horsepower To Motor Sales and Service", they mentioned that "mass production is unattainable without mass sales communication and stimulation by which people are made to want what you have to sell and are conditioned to a willingness to pay for it." Promotional information should tell a clear and interesting story in the language of the prospect, combining critical self-appraisal with a sincere interest in the customers' needs and requirements. In this presentation, thought was directed to editorial publicity in technical magazines, public-relations practices, national vs local advertising, direct mail, cooperative promotion ventures, and "taking facts, boiling them down and dressing them up" as newsworthy copy.

Shop Costs Analyzed

"The Cost Factor in the Motor Repair Shop" and "Do You Know Your Costs", discussed in sequence by Howard A. Lilly of the Tampa Armature Works, Tampa, Fla., and A. G. Bamford of the Sutherland-



Flexibility, Imagination and a Spiritual Quality in this Church Installation – by **LITECONTROL**

This lighting installation at the First Methodist Church, Sarasota, Florida exemplifies what can be done with *adaptations* of standard Litecontrol fixtures. We are proud of the ingenuity expressed in this job but more important, it shows how Litecontrol fixtures, either standard or modified, can be made to fit into almost any interior functionally and appropriately.

While incandescent lens box lighting was indicated, the Church Committee preferred a different type of system. Responding to the challenge, our District Sales Engineer, Mr. Frank Moos, of Tampa, Florida, in collaboration with the architect and engineer, visualized the symbolic and functional arrangement shown, with recessed fluorescent troffers in the shape of a cross.

All troffers have hinged covers — they may be relamped from a catwalk above the ceiling. Corning Albalite #66 glass diffuses the light. This glass is cloth bound on the outside edges to prevent any rattling or vibration from organ reverberations. With cross pieces omitted along the rows, except at the corners, the glass appears as a continuous piece. Four foot, Rapid Start lamps are used for ease in handling. They are wired on two and three circuits, to provide variable intensity.

If cost control is a major factor in a lighting installation, standard Litecontrol fixtures will save money — and do a quality job. Yes, and if modification of standard fixtures is required to solve a special problem, you can rely on Litecontrol for the touch of imagination the situation requires.

INSTALLATION: First Methodist Church, Sarasota, Florida

ARCHITECT: Garry A. Boyle, Tampa, Florida

ENGINEER: Nathan A. Grout, Tampa, Florida

CEILING HEIGHT: 25 feet

INTERIOR FINISHES: Ceiling off-white acoustic tile and plaster; pews dark mahogany; floors pale green carpet.

FIXTURES: In cross, 38-two-lamp Rapid Start troffers, with hinged covers for top service, Albalite #66 glass panels, with lamps wired on two circuits. Remainder of fixtures are 21-six-lamp 40 W Rapid Start 8 foot troffers, as above and 18-three-lamp 40 W Rapid Start 4 foot troffers. These are all wired on three circuits.

INTENSITY: All lamps on, average 25 footcandles maintained.

LITECONTROL
Fixtures

KEEP UPKEEP DOWN

LITECONTROL CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Here's The Box That Is Making Electrical Contractors Take Notice!

CAT. NO.
5-S-51 • 5-S-71

ARROW
4 11/16" SQUARE BOX

The Only Drawn Box With More K.O.'s On The Sides Than Any Other Box Available!

For general installations where maximum wiring room is required. Depth: 1 ½" or 2 ⅛". Available in any arrangement of K.O.'s up to 1 ¼". As many as 17 K.O.'s. Wiring capacities of 30 cu. in. and 42 cu. in. Hot-dipped galvanized finish is many times thicker than U.L. and Federal Specifications. Write for more complete details.

USED IN THESE PROJECTS:

Statler Hotels in Dallas, Texas, and Hartford, Conn.; Hudson River State Hospital, N.Y.; Fontainebleu Hotel, Miami Beach, Fla.; N.Y. Housing Authority Bldgs.; Various Military Projects,; etc.

When you have an installation problem not covered by our standard line, our engineers will design special units to your specifications.

Write for Our New Catalog.

ARROW CONDUIT & FITTINGS CORP.

129 30th STREET • BROOKLYN 32, N. Y.

Sales Representatives & *Warehouse Stocks
BALTIMORE, MD. • CHARLOTTE, N.C. • *CHICAGO, ILL. • *CINCINNATI, OHIO • DENVER, COLO. • *LOS ANGELES, CALIF. • *MIAMI, FLA. • NEW ORLEANS, LA. • NEW YORK, N.Y. • NEWTON CENTRE, MASS. • *PHILADELPHIA, PA. • ROCHESTER, N.Y.

Mrs. John R. Lange and Mrs. Myrtle M. King, Lange Electric Co., Baltimore, Maryland, and Mrs. Robert B. Floyd, Floyd's Electric Motor Service, Champaign, Il.

Schultz Electric Co., Ltd., Kitchener, Ont., Canada, collectively cited numerous examples of intelligent billing, indirect expenses, time clocks and unapplied labor, insurance and taxes, rent and depreciation. "Management needs every tool within reason to run a successful business," said Lilly, "and accurate shop cost is one of them. Indirect expense is a fertile field for fluctuation, and periodic analysis of reports should be made to check possible increases or decreases in direct labor." This was also emphasized by Bamford, who stated that "constant pressure between rising shop costs and lowered manufacturers' prices, due to their improvements in mechanization and mass production methods, is making it increasingly difficult for motor repair shops to rewind smaller-sized units at prices which will permit a profit while still maintaining prices attractively lower than new units." In conclusion, Bamford stated that repair work was constantly increasing in volume; there was more than enough work to keep every shop busy; intelligent billing could only be carried out by intelligently analyzing actual shop costs, and that cutting profits by competitors in order to underbid one another would only result in a vicious progressive cycle in which all profit would vanish although distribution of work might remain unchanged.

National Officers Elected

At the annual business meeting, newly-elected national president Charles J. Covington of the Dowser Electric Machinery Works, Mount Vernon, Ill., was officially introduced to delegates in his new capacity, as were Alfred Elson, Jr., New England Machine & Electric Co., Pawtucket, R. I., vice presi-

STORMS MEAN BUSINESS

...for standby electric plants!

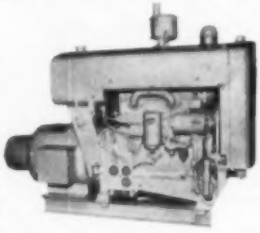
GET SET NOW WITH THE UNIVERSAL LINE!

Alert contractors are cashing in on the fast growing demand for standby electric plants by homeowners, small businesses, tourist courts, etc., for positive protection against power loss. You can take advantage of this extra profit potential, as well as enjoy sales of electric plants for regular applications with the complete Universal line.

Here are specially designed models for portable and emergency standby service. Low-cost, lightweight, easy-starting—rigged for home and business service. All the needed capacities, operating features—at prices that make selling easier.

There's 700-800 watt power for emergency or regular service in this low-cost Universal.

GASOLINE MODELS—in the selective Universal line, really competitively priced, are air-cooled models from 400 to 1200 watts—ready for service. Water-cooled models to 35 k.w.—all types of controls from manual to fully automatic where plant takes over when power fails.



Typical of the advanced diesel models is this 10 k.w. Universal.

DIESEL MODELS—the industry's most advanced line with definite sales advantages. Low-priced, compact, simpler operating, you're set to fill virtually every diesel generating set need with this complete line—8 to 35 k.w.—for always ready standby service, for heavy-duty continuous operation.

Get all the facts —ask about our profitable contractor plan and and get complete specifications and prices on these popular models. Write for the Universal story today.

UNIVERSAL MOTOR COMPANY
Founded in 1898
438 Universal Drive, Oshkosh, Wisconsin

New Sola rapid-start ballast is small, quiet, and cool

Typical of the quality of the complete line of Sola Fluorescent Ballasts is a new two-lamp design for 40WT12 rapid-start lamps. This new ballast (Cat. No. 624-427) provides small size *plus* new standards of coolness and quietness for its specific duty.

COOL OPERATION: ETL tests show copper heat rise is only 50.9° C. Low temperature rise results in exceptionally cool operation for ballasts of this type and size.

QUIET OPERATION: Exclusive Sola methods for core-and-coil assembly, case design, and compounding produce operational quietness exceeding that of other leading ballasts designed for similar duty.

Your area representative, listed below, will be happy to provide further information for you. He's one of a nationwide sales organization maintained by Sola Electric Co. to provide you with prompt service.

SOLA *Fluorescent* **BALLASTS**

CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414** • *NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464* • *PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988* • *BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354* • *CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400* • *KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382* • *LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431* • *TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554* • *Representatives in Other Principal Cities*

fast way to figure cable terminating needs

UNIT PACKAGE TERMINATING KITS FROM

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UNIT PACKAGE TERMINATING KITS FOR:

ARMORED CABLE

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RUBBER INSULATED CABLE

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● Be sure of the right materials, in the right amounts, in the right places, for every termination to be made in cable runs! PLM Unit Package Terminating Kits simplify planning...eliminate endless details in specifying, ordering and stocking. Each Kit contains detailed instructions and correct materials for terminating one cable of specified rating and type.

ONE order from PLM can take care of ALL your terminating or splicing needs. Ask for catalog or quotations.

PLM *Products, Inc.*

3875 West 150th St. • Cleveland 11, Ohio

WIRE AND CABLE FITTINGS AND ACCESSORIES

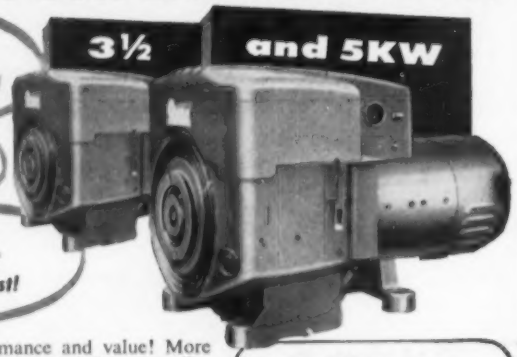
Armored Cable Terminators • Splicing and Terminating Kits • Conduit Ventilators

New ONAN CCK Electric Plants

MORE OUTPUT *per pound of weight!*

MORE OUTPUT *per gallon of fuel!*

MORE OUTPUT *per dollar cost!*



Way ahead in performance and value! More powerful, two-cylinder, air cooled Onan gasoline engines of 4-cycle, horizontally-opposed design give smooth, quieter, effortless performance. Short stroke and moderate speed cut engine wear, give longer life. Quality features include rotating Stellite-faced exhaust valves, solid Stellite valve seat inserts, full pressure lubrication. Onan's exclusive Vacu-Flo cooling system available for difficult or "buried" installations.

Completely Onan-built, with Onan gasoline engines direct-connected to Onan all-climate generators in compact, rugged units. Available in stationary, portable and standby models with a wide range of accessories.

PORTABLE MODELS

Available with carrying frames or 2-wheel dollies. Easily portable. Other Onan portable models: 500 to 10,000 watts.

Write for folder on all CCK models

Onan ELECTRIC PLANTS

D. W. ONAN & SONS INC.

2908 University Avenue Southeast, Minneapolis 14, Minnesota

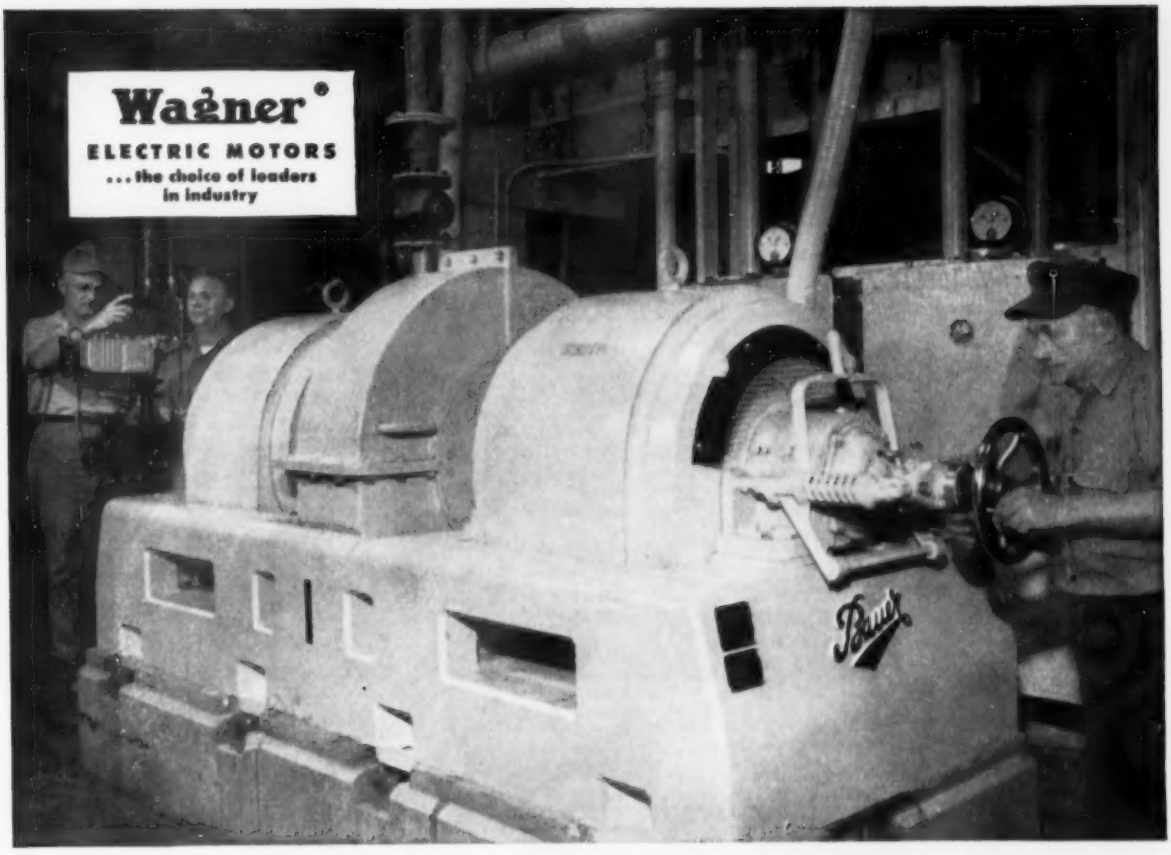
Charles B. Kaska, Kaska Electric Co., Chicago, Ill., and John E. Steffner, Chattanooga Armature Works, Chattanooga, Tenn.

dent; Paul M. Sievert, Sievert Electric Co., Chicago, secretary, and Frank W. Ross, Ross Electric Motor Shop, Fairmont, Minn., treasurer.

At this same luncheon meeting it was announced that first prize in NISA's 11th annual Shop Methods contest had been awarded to J. R. Kowalewski of the E. J. Robinson Co., Buffalo, N. Y. The award, amounting to $100, recognized his design for wedges for arranging the stator tooth sections of laminations in symmetrical order after they had been moved out of place. Second prize in the contest went to the Superior Electric Company of Marquette, Mich., for a clasp-type hook for dipping small stators. Third prize was won by E. Campbell of the Maintenance Co., New York City, for his design of a puller to remove pulleys and bearings, and fourth prize went to F. Finkernagel of Newark, Del., whose entry was a motor stethoscope. Ten additional cash awards were also distributed as honorable-mention prizes; these prizes going to personnel associated with the Maintenance Co., Inc., New York, N. Y. (3); Superior Electric Co., Marquette, Mich. (2); Egleston Electric Co., Marshalltown, Iowa, (2); Electric Motor and Repair Co., Richmond, Va.; the A & P Electric Co., St. Paul, Minn.; and Giles Armature Electric Works, Marion, Ill. All of these prizes, totalling $350, were given as the result of judging by W. W. Saunders of Lenawee Electric Co., Adrian, Mich., chairman of the Award Committee; Thomas Russell, Russell Electric Co., Mobile, Ala., and Frank W. Ross, Ross Electric Motor Shop, Fairmont, Mich.

Active Committeemen

General chairman for the convention was Joseph H. Previty of



Wagner Increment Start Motors Cut Initial Motor Costs... Cut Pattern Costs for Machine Manufacturer!

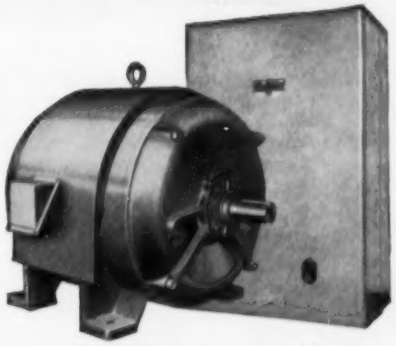
Recently the A. E. Staley Manufacturing Company placed an order with the Bauer Brothers Company for four double disc starch refiners, each requiring two 200 hp motors. The customer specified motors with auto-transformer starters to protect his plant's power distribution system.

Then a Wagner man stepped into the picture.

He showed both the Bauer Company and their customer how they could effect substantial savings through the use of Wagner Motors with Increment Starters which are far less expensive than motors with primary resistance or auto-transformer type starters... yet fully meet the polyphase motor starting recommendations of AEIC-EEI-NEMA.

Through co-ordinated engineering between Bauer and Wagner, stators, frames and rotors were furnished to Bauer, who made and assembled the endplates. The Wagner design permitted the use of identical endplate castings on both ends of each motor, and cut pattern costs.

Why don't you investigate the possibilities for savings by using Wagner Increment Start Motors on your big jobs? Your nearby Wagner engineer will help you select the increment motor and starter combination that meets your requirements. Call the nearest of our 32 branches or write for Bulletins MU-128 and MU-195.



Type RP polyphase motor in ratings to 400 hp with increment type starter

...to help America LIVE BETTER—*Electrically*

LIVE BETTER ELECTRICALLY

Wagner Electric Corporation
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

M56-6

NELEX Heat
Costs LESS . . . Gives MORE

Yes, you get more for your money when you use NELEX (MI) HEATER UNITS. These flexible, versatile, copper-sheathed cable heaters are finding *hundreds* of applications in dozens of major industries. Designed to operate at temperatures up to 500°F. in open air, they are suitable for temperatures up to 1,000°F. when oxygen is excluded. They are easy to install, require practically *no* maintenance, and will surprise you with their low operating costs.

Accurate thermostatic controls provide controlled temperatures and shut off power when heat is not required. What's more, NELEX units can be easily installed by any average electrician with standard tools and equipment.

For more complete information on applications and performance characteristics, write for bulletin 1603, or submit your heating problem to Nelson's experienced engineers.

NELEX MI HEATER UNITS a product of . . .

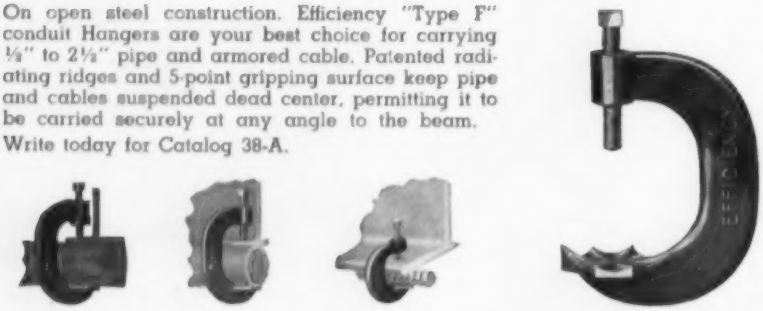
NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA

Manufacturers of electrical control equipment for Industry

Carry WATER, GAS AIR LINES, CABLE *at any angle to beams*

with "EFFICIENCY" CONDUIT HANGER "TYPE F"

On open steel construction. Efficiency "Type F" conduit Hangers are your best choice for carrying ½" to 2½" pipe and armored cable. Patented radiating ridges and 5-point gripping surface keep pipe and cables suspended dead center, permitting it to be carried securely at any angle to the beam. Write today for Catalog 38-A.



"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

Efficiency ELECTRIC AND MANUFACTURING CO.
EAST PALESTINE, OHIO

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT AND WIRE CABLE SUSPENSION

Bassil B. Roach, Whitney Electric Co., Toledo, Ohio, and Graydon E. Lombard, Lombard Electric Service, Caribou, Maine.

Penn Electric Motor Co., Philadelphia, who was also NISA national president during the past year. Co-chairman and convention treasurer was C. R. Durand of H. N. Crowder, Jr., Co., Allentown, Pa., while Ralph O. Kufen, Kufen Electric Motors and Engineering Service, Hatboro, Pa., served as program chairman. Convention secretary was Frank A. Schaef of Electrical Maintenance Equipment Co., Philadelphia. Schaef also served as secretary of the local Quaker City Chapter sponsoring the convention.

Mrs. Milton H. Eisenhardt of Haddonfield, N. J., was in charge of the women's program, assisted by Mrs. F. R. Pisano, co-chairman.

NALMCO Holds Annual Conference

The National Association of Lighting Maintenance Contractors met for a three-day meeting at Hotel Hershey, Hershey, Pa. on April 16-18. It was this young group's third annual conference, and was attended by over 90% of its total national membership. Business sessions began promptly at 9:30 AM and carried through until 5:30 PM each day. These sessions consisted of reports of the various committees covering work done during the past year, of talks by various invited speakers, and of round-table discussions on a wide variety of problems and activities of interest to all members.

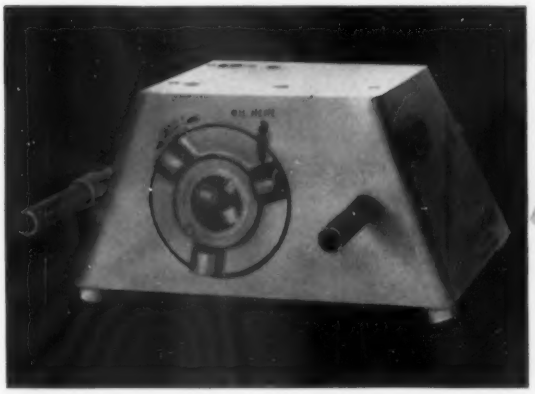
During closed sessions reports were submitted by various committees, including: Membership, Finance, Syndicate Purchase, National and Syndicated Accounts, Materials Testing, and Nominating Committees. One of these sessions was devoted to Association business, including internal organization and aims of the association.

R. L. Zahour of Westinghouse Lamp Division, Bloomfield, N. J.,

SPECIAL *Trade-in* OFFER!

BY OSTER

To meet the tremendous demand for factory rebuilt power vise stands, Oster offers



$50 ALLOWANCE

for any Oster No. 422 Power Vise Stand, complete with motor, regardless of age.

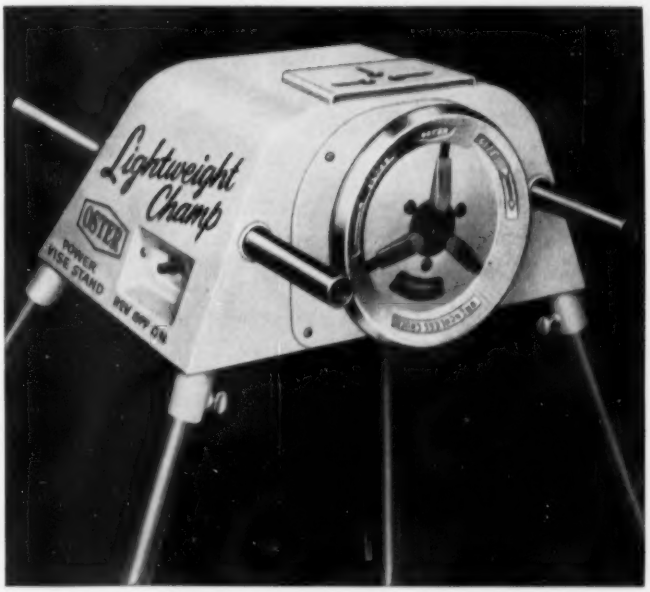
TOWARD THE PURCHASE OF THE NEW, IMPROVED

OSTER No. 432 Lightweight Champ

ACT NOW—Take advantage of this "first-time-in-history" opportunity to trade in your old No. 422 Power Vise Stand on the latest model Oster No. 432 "Lightweight Champ."

SPECIAL OFFER—Regularly priced at $265.00, the new Oster No. 432 costs you only $215.00, and your old No. 422, during the months of May and June, 1956.

EXPIRES JUNE 30—See your Oster Distributor for complete details on this sensational trade-in offer. Call him *today!*



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1313 East 289th St., Wickliffe (Cleveland), Ohio

BUILDERS OF COST-REDUCING THREADING EQUIPMENT SINCE 1893

Here's how STANDARD helps solve Transformer Problems

Dry-Type Load Center Transformer, 1000 KVA, with primary disconnect switch and low-voltage circuit breaker. One of a complete line of transformers developed by Standard for every class of indoor or outdoor service.

HOW TO USE STANDARD TRANSFORMER ENGINEERING SERVICES

Call your nearby Standard Transformer engineering representative. He'll work with you to determine the best solution for your unit sub-station problems and will present an efficient, economical solution. No need to choose stock designs. Standard will incorporate any special components you specify. Let us show you how you can have the best transformer for the job. Call your Standard representative today!

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THE STANDARD TRANSFORMER COMPANY

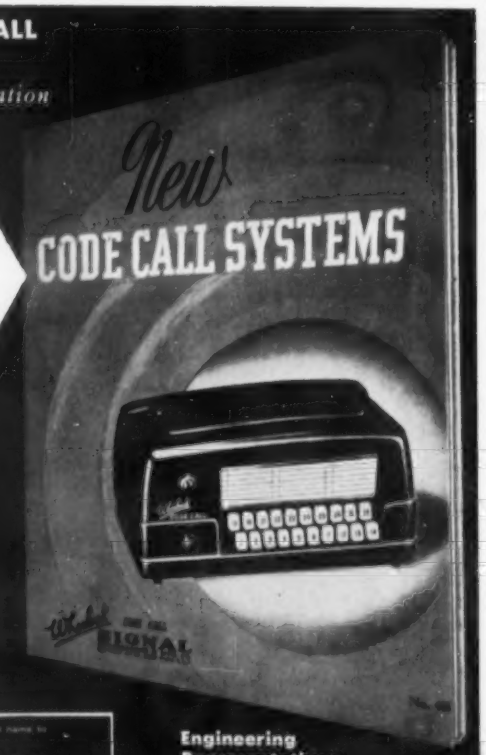
WARREN, OHIO
REPRESENTATIVES IN PRINCIPAL CITIES

WHEELOCK CODE CALL

for immediate communication

Descriptive Bulletin 4B-3 available on request. Write for your copy now to Wheelock Signals, Inc. Long Branch, N. J.

The busy switchboard operator just presses the button; a numerical code call sounds off throughout the building and the person being paged responds via the nearest telephone. The cycle is as simple as that. Also learn how easy it is to install a Wheelock Code Call System with any desired combination of chimes, bells, horns and other signalling devices.



Wheelock SIGNALS
CODE CALL LONG BRANCH, N.J.

Engineering Representatives in Principal Cities

BETWEEN SESSIONS at the 3rd annual conference of NALMCO at Hershey, Pa., lighting maintenance service problems were discussed by (l. to r.) Melvin H. Galbraith of Cedar Rapids, Iowa, Jack Gillespie of Toronto, Canada, and Waring R. Steiner of Savannah, Ga.

who is also Chairman of the Lighting Maintenance Committee of the Illuminating Engineering Society, demonstrated the new IES Dirtometer, and described the work now being done on lighting maintenance research by the IES committee.

Richard Lundgren of the Large Lamp Department, General Electric Co., Nela Park, discussed direct mail promotion of lighting maintenance and exhibited a wide variety of direct mail letters, leaflets, brochures, etc. which have been developed to help lighting maintenance contractors sell all types of lighting maintenance services.

John Holland of Sylvania Electric Products Inc., Salem, Mass., addressed the group on the subject of selling lighting maintenance to users of lighting, and especially to large national retail organizations.

Two NALMCO members, Robert and Jim Watson, of The Fluorescent Maintenance Co., Denver, Colo., discussed sales and advertising, and gave results on specific mailings, of which samples were distributed. Jim Watson presented a four-page proposal form which his firm uses with lighting maintenance prospects, and went through the proposal form to discuss the various sections in detail. He also discussed in detail the lighting maintenance contract agreement form which his firm uses.

Herbert Mendelsohn, of Sun Ray Lighting Corp., Kansas City, Mo., described the office forms, records, and procedures which he uses in the operation of his lighting maintenance service, showing how his methods vary from those in general use, and the resulting advantages.

Round table discussions took up a considerable period of time each

Lighting by DAY-BRITE Lighting Fixtures makes the big difference . . .

Mr. Emmet G. Molz, Hickson Electric Corp., Rochester, N. Y.

"Our customers are happy"

"One of the things we like most about Day-Brite is the fact that our customers are really proud of their lighting when the job is finished. Naturally, that builds our reputation and helps us get more good jobs.

"Our foremen are impressed with the way they can put in Day-Brite fixtures. They go up fast, without any messing around—are easy to line up in long, straight runs.

"All in all, we're for Day-Brite—have been for a long time."

By making these comments, Mr. Molz adds his name to thousands of electrical contractors, from Coast to Coast, who favor Day-Brite's many superior features.

Certified Lighting

61144

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

"DECIDEDLY BETTER" DAY-BRITE Lighting Fixtures

Day-Brite Lighting, Inc.
5402 Bulwer Ave., St. Louis 7, Missouri

QUALITY BUILT!
ECONOMICAL!
FLEXIBLE!

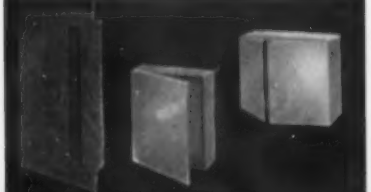
Easily Installed
Saves Time and Money!

BOSS
WIREWAY
CUT OUT BOXES
CABINETS

QUALITY-BUILT
Code gauge metal, 100% UL approved construction. Firm, but easy-out knockouts. Gray baked enamel finish.

ECONOMICAL
Many years' experience, modern production methods, assure quality—reasonable prices.

FLEXIBILITY
Choice of flanged or flangeless wireway, separate slide-lock or attached hinged cover. Full line lengths, sizes, elbows, junctions, cabinets. Adaptable to any electrical distribution installation.



SOLD THROUGH DISTRIBUTORS ONLY
Write Today for Catalogs and Prices
THE HUENEFELD CO.
Cincinnati 25, Ohio

TWO SOUTHERNERS learn about direct mail promotion of lighting maintenance at 3rd annual convention of NALMCO in Hershey, Pa., as Jerome Gimbel (center) of Chicago tells Malger H. Gray, (left) of Tampa, Fla. and Walker R. Fluornoy, of Columbus, Ga. about his program.

day, and covered such topics as personnel, wages, bonuses, uniforms, and training. Also discussed were group replacement, profits, and service methods. These discussions offered an opportunity for exchange of ideas, and were participated in freely by all present.

New officers elected for the coming year are as follows: President—Edward I. Creed, Cleveland; Secretary-Treasurer—Herbert Mendelsohn, Kansas City, Mo.; Regional Vice-Presidents: Eastern—Francis Clark, Waterbury, Conn.; Southern—Walter Fink, Jr., Atlanta, Ga.; Central—Jerome Gimbel, Chicago, Ill.; Mid-Western—Glen Shatola, Milwaukee, Wis.; and Western—Robert Watson, Denver, Colo. Walter Fink, Jr. of Atlanta, Ga. was President during the past 1955-56 year, and Francis Clark of Waterbury, Conn. was Secy-Treas.

Kansas City, Mo., was approved as the site for NALMCO's 1957 conference, to be held during the month of April.

ACTIVE IN NALMCO since its organization four years ago are Francis Clark (left) and Richard Platt, both of Waterbury, Conn. Clark was secretary-treasurer during the past fiscal year, was elected during recent annual conference in Hershey, Pa., as Eastern Regional Vice President.

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THE HANDIEST
PLIER EVER
DESIGNED

CHANNELLOCK®
No. 420

Skilled mechanics everywhere tell us that the Channellock No. 420 is the handiest plier of them all . . . the plier they reach for more often than any other. They like its all 'round usefulness . . . its pipewrench grip . . . its streamlined design for hard-to-get-at jobs. You'll like Channellock, too . . . for the same reasons. But . . . when you ask for a Channellock, be sure you get a *genuine* Channellock. Only Channellock has undercut, interlocking channels that can't jump out no matter how hard you grip. So look for the trade mark on the handle.

CHANNELLOCK
first choice of skilled Mechanics

CHAMPION DeARMENT TOOL COMPANY
MEADVILLE PENNSYLVANIA

Familiar symbols of safety

PROTECTION OF WIRING

The only wiring system approved by the National Electrical Code as moisture-, vapor-, dust- and explosion-proof for use in hazardous locations and occupancies is a standard-threaded rigid conduit.

Wherever electrical wiring must function safely and efficiently in hazardous locations, install Youngstown Buckeye rigid steel conduit. It is easy to bend . . . easy to fish wires through . . . and economical, because its greater corrosion resistance means a longer, trouble-free service life. When you install Buckeye you're one of thousands of contractors, owners and architects who make it one of the world's best known brands of standard-threaded, full-weight rigid steel conduit.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices - Youngstown 1, Ohio
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QUALITY YOUNGSTOWN SERVICE

Ask your distributor for Youngstown Buckeye Full Weight Rigid Steel Conduit and Youngstown Electrical Metallic Tubing.

for you...

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Gentlemen: Please send me full details and photos of Baker Scaffolds in action, without obligation.

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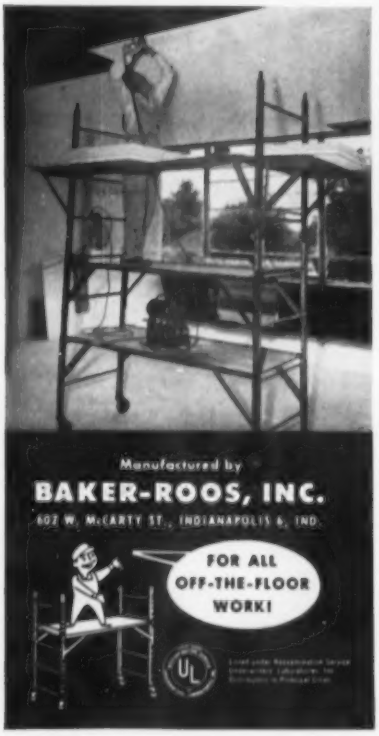
RIGHT HEIGHT FOR BETTER OFF-THE-FLOOR WORK!

Your men are up to the right working height faster, safer and with less expense when they use BAKER SCAFFOLDS. No X-bracing . . . spans furniture, equipment and stockpiles to work in occupied areas. Large platforms, adjustable every 3 inches. Always level, even on stairways. Ball-bearing, rubber-wheel casters. Get the facts on BAKER SCAFFOLDS first! Write for Bulletin 563.



Certified Lighting Program Expanding

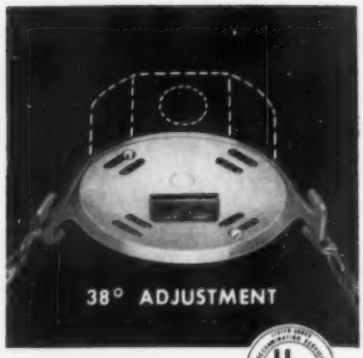
The Certified Lighting program has achieved national status. Announced in mid-1953 (*EC&M*, July, 1953, pp. 197-199), it has now been accepted and put into operation in 17 major communities and trading areas across the nation under sponsorship of local lighting bureaus organized and set up by local all-industry electrical groups.

Objective of the Certified Lighting program is to train lighting salesmen in the fundamentals of illumination and lighting sales, to enable them to sell better lighting installations. Inherent in the program is a lighting certification plan, whereby lighting plans meeting certain specified requirements may be certified, and sold to the user as a Certified Lighting installation. Certification is done by a duly appointed local certifier, operating under a prescribed set of rules established by the National Lighting Bureau and approved for use by the local Lighting Bureau.

Of the 17 local Lighting Bureaus now in operation, 11 were active during 1955, and five more have been set up during the first half of 1956. Electrical industry groups in other local areas now have the program under consideration and are expected to set up local Lighting Bureaus during the 1956-57 fall-winter season.

To date a total of 1340 lighting salesmen and lighting engineers have been trained in illumination fundamentals and lighting sales, in special schools sponsored by the local Lighting Bureaus. Of these, 53% have been electrical contractors' staff employees, 24% from distributors' staffs, 16% from utilities' staffs, 3% from lighting fixture manufacturers and representatives, and 4% from the staffs of engineers and consultants, architects, inspectors and others.

Local Lighting Bureaus established and now in operation, the local sponsoring group, and number of students trained are as follows: *Rhode Island*, Electrical League of Rhode Island, Providence—106; *Eastern Massachusetts*, Electric Institute of Boston—181; *San Diego County*, Bureau of Home Appliances of San Diego County, San Diego, Cal.—90; *Northern California*, Northern California Electrical Bureau, San Francisco—217; *Southwestern Ohio*, Cincinnati Electrical Association, Cincinnati—86; *Chattanooga*, Electrical League of Chattanooga, Tenn.



NEW

low cost fixture hanger

Fast, easy, lower cost. This new Ideal-Simplet fixture hanger mounts directly on 3¼" or 4" outlet boxes. Grounds fixtures to conduit systems. Has 38° total adjustment by means of slots and off-set hooks. Makes fixture hanging a snap!

Two styles, both low cost. Available in standard 2-wire or 3-wire models with Hubbell #5284 receptacle. Complete with two 5' chains, hooks and cord clips.

2-WIRE MODEL
No. K-121 only $1.00

3-WIRE MODEL
No. K-122 $1.75

SEE YOUR WHOLESALER, OR WRITE

IDEAL

IDEAL-SIMPLET FITTINGS, INC.
A Subsidiary of Ideal Industries, Inc.

1041 Park Avenue,
Sycamore, Illinois

—60; *Worcester County*, Worcester County Electrical League, Worcester, Mass.—35; *Rochester*, Rochester Electrical Industry Joint Board, Rochester, N. Y.—55; *Carolinas Western Piedmont*, committee of leaders in local lighting industry, Charlotte, N. C.—120; *Los Angeles*, Commercial-Industrial Lighting Division, Electric League of Los Angeles, Inc.—74; *Middle Eastern Michigan*, Electrical Association of Detroit—136; *Northwestern Connecticut*, Adequate Wiring Association of Waterbury, Conn.—70; *Southwestern Connecticut*, committee of leaders in local lighting industry, Norwalk, Conn.—30; *Sacramento Valley*, Sacramento Valley Electric League, Sacramento, Calif.—40; *New Orleans*, Electrical Association of New Orleans—40; *Nebraska-Iowa*, Nebraska-Iowa Electrical Council, Omaha, Nebr.—first classes to be held this fall; and *Jackson, Miss.*, committee of leaders in local lighting industry—first classes to be held this fall.

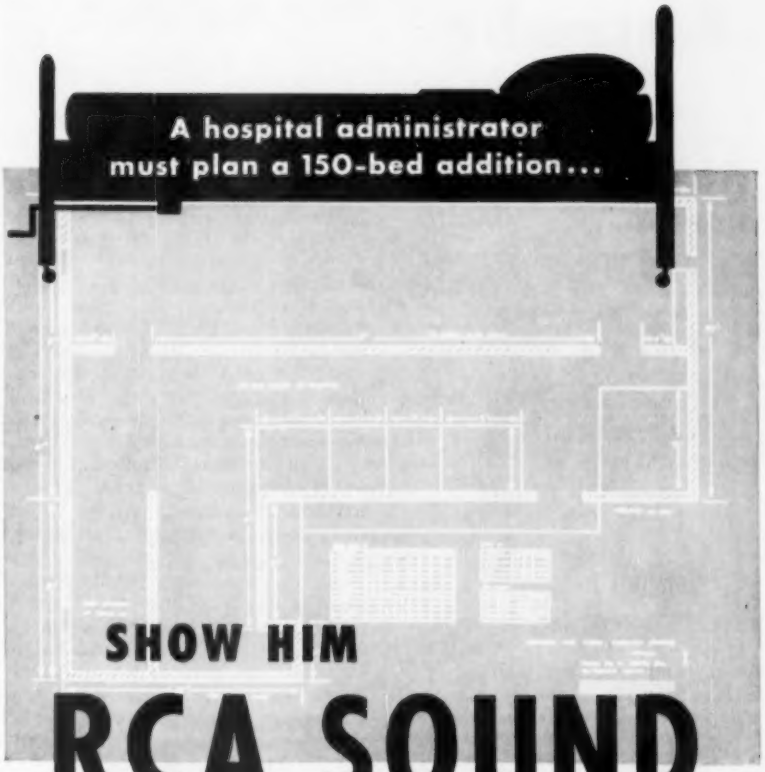
All local Lighting Bureaus set up their own certifying authorities, which check plans and stamp them for certification when they are in accordance with minimum standards. Also, these local Bureaus set up and operate the schools to provide sales and technical training. The entire program has been developed and services made available to local groups by the National Lighting Bureau of the Industrial and Commercial Lighting Section of the National Electrical Manufacturers Association.

Commercial Distribution At 480/277 Volts

High-voltage distribution system design—its problems, benefits and possibilities—proved a lively topic for the season's final meeting on May 17 of the Lighting Division, New York Section, American Institute of Electrical Engineers.

Felix Graham, chief electrical engineer with Syska & Hennessy Construction Engineers, New York City, described his experiences in the design of multi-story commercial building using 480/277-volt systems.

In the first analysis, he stated, much depends upon the attractiveness of the system to both the building owner or prospective tenant and the electrical utility. The utility is likely to insist upon an initial minimum demand to make installation of feeders and transformers economical; however, once they are serving a particular



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RCA SOUND

to Clinch the Business

RCA moves you several jumps ahead of the competition when you bid on sound system specs for any type construction. The reason: RCA has *the* name that's known for dependability and quality in electronics. And this is quality that costs no more.

You sell all the advantages of RCA engineering . . . the only sound-system engineering backed by the world-wide reputation and precision-manufacturing skill of the Radio Corporation of America. Performance of every RCA component year after year *shows* the difference. They're flexible components, too . . . a complete, intermatched audio line. And you can sell RCA service, nationwide service with replacement parts ready any time, should they be necessary.

Your RCA Engineered Sound Distributor will help you in every way as you plan a sound installation. He's ready to aid you in custom-designing for individual requirements. He stocks the components you need to do any job fast. Get started rolling up RCA Sound System business *now* . . . with "Sound in Industry," the 12-page RCA booklet that tells the whole RCA quality story. There's a lot in it for you if you mail the coupon today!

SOUND PRODUCTS
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Please send me—at no obligation—the RCA booklet "Sound in Industry."

Name _____ Title _____
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Address _____
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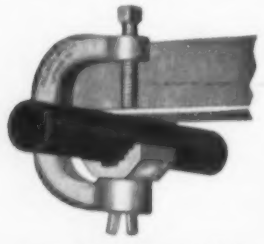
Latrobe *Electrical* Products

Easy To Install

There are no excess screws, wires or complicated parts in "Latrobe" Floor Boxes or Wiring Specialties. Their design and mechanism is simple, sure and compact. That is why "Latrobe" Products are so quick and easy to install—so efficient in service.

ADJUSTABLE FLOOR BOXES

Adjustable Floor Boxes are now banded which makes them fire-proof—come in single round or square bodies—also furnished in square single gang, two gang, three gang and four gang types.



PIPE OR CONDUIT HANGER

Most economical and best pipe hanger sold today. The saddle comes firmly fastened to the hanger bracket and cannot drop out. For hanging pipe or conduit ½", ¾", and 1" to steel beams up to ⅜" thick. Larger sizes for larger pipe.

Latrobe Products

Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes . . . Cover Plates
Junction Boxes . . . Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports . . . Fish Wire
Staple and Cable Clips
Write for new catalog

Sales Representatives in all principal cities.

Fullman Manufacturing Co.
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area, smaller loads are usually accepted. From the owner's or user's standpoint, the nature of his load has an important bearing on the choice between 480/277 or 208/120 volts.

Systems involving extensive incandescent lighting seldom are well suited to high voltage unless extensive refrigeration or air conditioning motor loads are also included, due to the cost of the required transformers. The National Electrical Code does not recognize use of incandescent lamps at voltages higher than 150 volts for other than industrial occupancies, and to date practical higher-voltage incandescent lamps have not been developed.

From a cost standpoint, the lower currents effect some savings in branch circuit wiring, but fluorescent lamps and auxiliaries, fixtures and panelboards run somewhat higher at higher voltage ratings, thus balancing the branch circuit savings. However, economy in feeder distribution can be substantial. The greater the load and length of run, the greater are the savings. Costs are lowered considerably also through the use of the higher voltage motors.

Mr. Graham discussed the short circuit problem, which is more serious at higher voltages, since faults are seldom self-clearing. Depending upon the nature of the load and the physical location of the main distribution equipment, means available for reducing possible short-circuit current values include the use of reactors, isolated-phase high-reactance bus or cable, or high-interrupting-capacity fuses.

Possibilities for the future appear promising, he said. At present in New York City alone six buildings using 480/277-volt systems have been completed, six more have been approved by both the owners and utility, five more by the owners alone, and an additional five are in the planning stage—a total of 22 for the foreseeable future. Experience has shown that no hard-and-fast rules can be applied to determine whether high-voltage distribution will prove economical for a particular building. An estimated savings of several thousand dollars at the beginning may be deceiving, since many unforeseen little expenses creep in due to unfamiliarity with the system. Each application must be studied and estimated in detail, and indicated savings should be substantial before the high-voltage system is adopted.

HERE IT IS . . . .
Designed and Manufactured By
MULBERRY . . . .

The greatest improvement in outdoor receptacles in years. . . . An outdoor plate that will use any standard 2 wire or 3 wire grounded type receptacle.
Can be had with or without receptacles.
Simplifies the stock problem.

MULBERRY METAL PRODUCTS INC.
280 BADGER AVE., NEWARK 8, N. J.

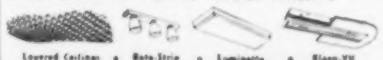
One Fixture Cost . . . One Installation Cost
NEO-RAY **ROTO-STRIP**
C.S.A. APPROVED Pat. Pend.

GOES TO THE FAIR

Roto-Strip is chosen for fair, carnival and bazaar lighting because it costs so little . . . requires no installation . . . easy to carry . . . easy to ship . . . and gives an abundance of light on any object. This complete shallow unit (available for surface, corner or recessed mounting) has built-in recessed roto sockets that swing 90° in all directions through a complete 360° circle . . . and stay put at any angle. Available in stock sizes of 2', 3', 5', and 8' lengths.

Surely Roto-Strip has a place in your plans.

Send For Complete Catalog No. 541B • *Sold Through Wholesale Distributors*
MANUFACTURERS OF LIGHTING FIXTURES INCLUDING



Louvred Ceilings • Roto-Strip • Luminette • Bloom-Vu

NEO-RAY PRODUCTS, Inc.
315 East 22nd St. • New York 10, N. Y.

WHAT'S THE LAW?

By Jack and Michael Strauss

QUESTION: May an electrical contractor collect extra compensation because a building isn't ready for him to do his work?

Mr. Smedly was entrusted by his firm to arrange for the construction of a bigger and better factory. Immediately, he began handing out contracts. One went to a general contractor, who was to do the building, and another he gave to Mr. Piper, who was to install and complete all necessary electrical work.

Unfortunately, Mr. Smedly discovered that constructing factories, like true love, rarely runs smoothly. It took 16 months to complete the factory despite the fact that his contracts specifically required that all work was to be finished in seven. The result? Mr. Smedly found himself with an unexpected headache.

"If the work had progressed to completion according to the general contract", Mr. Piper complained, "I could have finished the electrical work within seven months as called for in my contract. Because of the delays, I had additional costs and expenses. I demand extra compensation!"

"That's ridiculous", retorted the harrassed Mr. Smedly. "I won't give you an extra penny. We had bad weather, a scarcity of labor and innumerable unfortunate mishaps. The delays weren't my fault. All extensions given to the general contractor were approved by the supervising architect. What do you want from me?"

Mr. Piper, however, remained steadfast in his claim for additional compensation and took the matter to court.

THIS WAS THE DECISION: The Court held for the electrical contractor. It said where the owner of property initiates a program of construction and awards separate contracts for integrated work . . . nothing in the contracts being to the contrary . . . the owner is impliedly obligated to keep the work in such a state of forwardness as will enable a given contractor to complete his work within the time fixed.

(Based upon a 1941 Washington Decision and a 1944 Circuit Court of Appeals Decision. State laws vary. For personal guidance, see your local attorney).

R&S *Announces ...*

A New Line of Explosion-Proof
300/500 Watt INTERCHANGEABLE TYPE
Pendent and Ceiling Lighting Fixtures
Class I, Groups C & D

Russell & Stoll has developed a new line of explosion-proof 300/500 watt lighting fixtures, designed to meet modern lighting conditions.

These new fixtures provide safe, efficient lighting for hazardous locations at moderate cost. Fixture construction is simple and truly explosion-proof, with heavy walls of high strength cast aluminum alloy. Lamp and wiring compartments are separate and individually explosion-proof.

This new 500 watt Type EL fixture-globe-ceiling assembly will fit the standardized 100 to 300 watt pendent and ceiling bases interchangeably, providing for a flexible range of lighting levels from 100 to 500 watt whenever wattage changes are necessary to meet revised requirements.

Pendent and Ceiling Types

Write for literature #51556-4

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RUSSELL & STOLL

PRECISION-BUILT ELECTRICAL EQUIPMENT – SINCE 1902

REPORTS ARE POURING IN FROM EVERYWHERE–

"The Barth Cable Puller is the greatest thing that has hit the industry in 30 years!"

"Saves our men many hours of back breaking labor! Paid for itself in a week!"

Don't waste precious skill on old fashioned back breaking methods of pushing tape and pulling wire. Put a Barth Cable Puller to work NOW pushing tape and pulling wire the modern Barth way — electrically!

THE BARTH CORPORATION, 12664 Brookpark Road, Cleveland 30, Ohio

Please send complete Cable Puller data folder and prices.

NAME _____ YOUR COMPANY _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

Pat. Pend.

KLEIN KUT PLIERS

for both regular and heavy-duty cutting

It was Klein that produced the first and still the finest regular side-cutting plier. Klein also gave the industry the modern, streamlined version so much in demand.

And it's Klein again with a new, high leverage cutting plier for light- or heavy-gauge wire, including No. 2 weatherproof hard drawn solid copper wire, and A.C.S.R.

There's no extra hinging of any kind—no uncomfortable wide-spread handles—with this new Klein-Kut Plier. The offset hinge permits the extra-high leverage and operation is as smooth and easy as with any other Klein Plier. Forged from high-grade tool steel, individually fitted, tempered, adjusted and tested. Ask for No. 213-9 N.E. for streamlined pattern.

Regular pattern available

Same high-leverage design, but in the original Klein side-cutting pattern. Ask for No. 213-9.

Write for free Copy of Bulletin 1054

* Trade Mark

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York.

"Since 1857"

Mathias KLEIN & Sons

DATES AHEAD

International Association of Electrical Inspectors — Virginia Chapter — Roanoke Hotel, Roanoke, Va., June 25-26; **Southern California Chapter**—Santa Monica, July 25; **Southern Section**—Conrad Hilton Hotel, Dallas, Texas, October 22-24.

National Association of Electrical Distributors—48th annual convention, Ambassador-Chelsea Hotels, Atlantic City, N. J., Week of June 10.

American Society of Heating and Air-Conditioning Engineers — Semi-annual meeting. The Shoreham, Washington, D. C., June 18-20.

New York State Association of Electrical Contractors and Dealers, Inc.—Annual convention, Saranac Inn, Saranac Inn, N. Y., June 24-29.

International Association of Electrical Inspectors — Section meetings: **Northwestern Section** — Newhouse Hotel, Salt Lake City, Utah, Sept. 10-12; **Southwestern Section**—Hotel and city to be announced, Sept. 17-19; **Western Section**—Statler Hotel, St. Louis, Mo., Sept. 24-26; **Canadian Section**—King Hotel, Toronto, Ontario, Canada, Oct. 12-13; **Eastern Section**—Wentworth - by - the - Sea, Portsmouth, N. H., Oct. 15-17; **Southern Section**—Statler - Hilton Hotel, Dallas, Texas, Oct. 22-24.

Illuminating Engineering Society—National Technical Conference, Hotel Statler, Boston, Mass., Sept. 17-21.

Instrument Society of America—Eleventh Annual Instrument Automation Conference and Exhibit, New York Coliseum, New York City, September 17-21.

National Electrical Contractors Assn. 55th Anniversary convention and Second National Electrical Exposition, Sheraton-Palace Hotel, San Francisco, Calif., September 23-29.

National Electronics Conference—Hotel Sherman, Chicago, Ill., Oct. 1-3.

International Association of Electrical Leagues — 21st annual conference, Sheraton - Cadillac Hotel, Detroit, Mich., October 3-6.

National Electrical Manufacturers Association — Annual meeting, Traymore Hotel, Atlantic City, N. J., November 12-16.

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Among the Manufacturers

Headquarters Announcements

Anderson Electric Corp., Birmingham, Ala., is the new name of Anderson Brass Works, Inc.

Federal Pacific Electric Co., Newark, N. J.—Philip S. Cannon, assistant to the executive vice president and member of the executive staff.

Ridge Tool Co., Elyria, Ohio—William L. Parcell, vice president.

Sylvania Electric Products Inc., New York, N. Y.—William White, director; B. S. Ellefson and M. E. Pettegrew, vice presidents; Arthur L. Chapman, vice president-manufacturing.

Mycalex Corp. of America, Clifton, N. J.—W. D. Kleppinger, executive assistant to the president.

North American Electric Lamp Co. has relocated to 1520 North 13th St., St. Louis, Mo.

Jefferson Electric Co., Bellwood, Ill.—Henry A. Wallis, sales manager of the special products division.

Day-Brite Lighting, Inc., St. Louis, Mo.—D. J. Biller, chairman of the board of directors; O. W. Klingsick, president.

C & D Batteries, Inc., Conshohocken, Pa.—L. R. Gardner, member of the board of directors; H. E. Jensen, vice president in charge of engineering and marketing.

Mercoid Corp., Chicago, Ill.—W. E. Jones, sales manager; P. J. Provost, manager of industrial controls division.

General Electric Co., Distribution Assemblies Dept., Plainville, Conn.—John S. Macdonald, general manager.

Edwin F. Guth Co., St. Louis, Mo.—E. L. Ehret, member of the engineering and technical advisory staff.

National Electric Products Corp., Pittsburgh, Pa.—D. W. Rice, product sales manager of the conduit division.

Aerovent Fan Co., Inc., Piqua, Ohio—A. W. Roth, manager of the new large propeller division.

Aluminum Co. of America, Pittsburgh, Pa.—H. E. Bakken, J. P. Haight, Lawrence Litchfield, Jr., R. T. Whitzel and E. B. Wilber, vice presidents.

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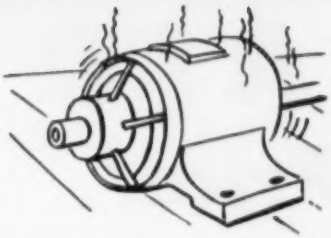

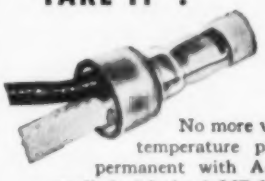

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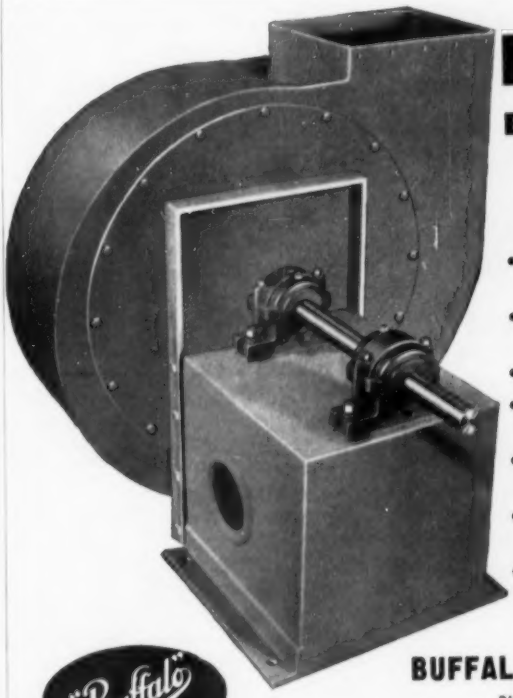

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Pittsburgh, Pa.—F. W. Godsey, Jr., A. M. Kennedy, Jr., F. M. Sloan and W. W. Smith, vice presidents.

Fairchild Camera and Instrument Corp., Syosset, N. Y.—R. E. Comstock, general sales manager of the electrical products div.

General Electric Co., Philadelphia, Pa.—Frank E. Stehlik, general manager of the low voltage switchgear dept.

Okonite Co., Passaic, N. J.—Rhea P. Lapsley, vice president in charge of research and product development.

Regional Appointments

MIDDLE ATLANTIC

Black & Decker Mfg. Co.: new sales and service branch in Progress area of Harrisburg, Pa., Joseph E. Watson, service manager.

Graybar Electric Co., Inc.: E. R. Yonkers, district manager and W. L. Johnson, manager-inside construction sales in New York City.

Century Electric Co.: Gunar Moe, district manager of the New York office.

National Electric Products Corp.: Eastern Regional and New York District office relocated to 545 Madison Ave., New York City.

Smithcraft Lighting Div.: J. A. Witter, representative for western Pennsylvania, West Virginia and the eastern part of Ohio. Offices in Pittsburgh.

Pass & Seymour, Inc.: Joseph Kehoe, special representative to engineering and architectural professions in New York City office.

Electrical Controller & Mfg. Co.: Howard Scheidle, district sales manager in Philadelphia, Pa.

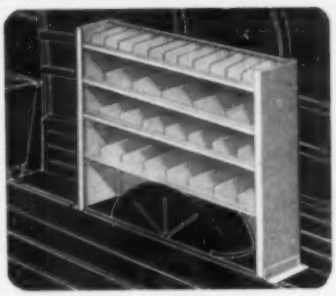
Miller Co.: William J. Byrne, sales representative for upper New York state with headquarters in Syracuse.

Carboloy Dept, General Electric Co.: E. L. Kapernaros, carbide cutting tool sales representative for Newark, N. J., area.

Permacel Tape Corp.: R. L. Gentry of Rutherford, N. J., representative for New Jersey and New York; Edward Braddock, representative for southern New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia and Virginia with offices in Haddonfield, N. J.

SOUTH ATLANTIC

Interlectric Corp., Great Western Div.: Paul H. Noe of Atlanta, representative for Georgia, Alabama and Florida; C. B. Turbeyville,



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EAST CENTRAL

Mycalex Corp. of America: Harry G. Lake, commercial engineer for the east central district, offices in Cleveland Heights, Ohio.

Allis-Chalmers Mfg. Co.: A. P. Bowman, manager of the Rockford, Ill. branch of the Industries Group.

Square D Co.: William Younger, eastern sales manager with headquarters in Detroit, Michigan.

Permacel Tape Corp.: Jack Thorpe, Michigan representative.

Pass & Seymour, Inc.: Ivan Horrigan, Ohio Valley district manager; Joseph Zeisler, sales representative for northern Ohio area.

WEST CENTRAL

Miller Co.: William D. Faust, New Orleans, sales representative for Louisiana, Mississippi and Alabama.

S & C Electric Co.: A. T. Hawkins, sales engineer for southern Illinois, Iowa and eastern Missouri.

Warner Electric Brake & Clutch Co.: Duane Branaka, St. Louis district representative.

Graybar Electric Co., Inc.: G. D. Johns, Baton Rouge, La. manager; E. L. Drummond, manager at Beaumont, Texas branch.

Pittsburgh Reflector Co.: D. D. Murray, lighting representative for St. Louis area.

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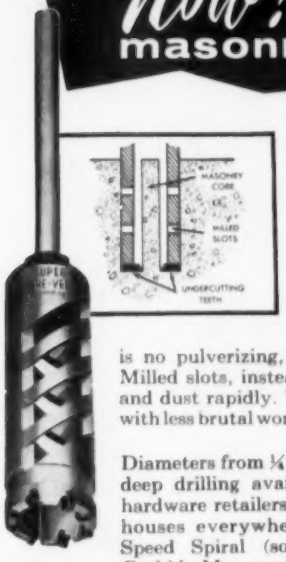

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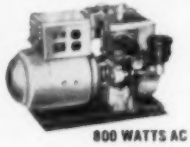
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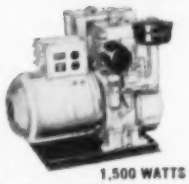
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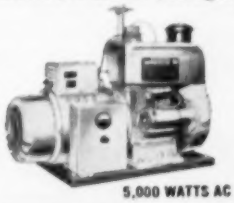
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Meinert, Minneapolis, Minn. sales representative.

Permacel Tape Corp.: H. W. Knaggs, representative for Iowa, Nebraska, Kansas, Missouri, and southern Illinois.

Orangeburg Mfg. Co., Inc.: C. F. Arnold, North Central district sales manager. Offices in Kansas City.

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Prescolite Mfg. Corp.: L. C. Papp and Edward Sholander, sales engineers in the Los Angeles, Calif. office.

C & D Batteries Inc.: G. E. Stephenson, representative for Phoenix-El Paso area.

Rodale Mfg. Co., Inc.: Walter Rubin, Los Angeles, West Coast representative.

Smithcraft Lighting Div.: William Sylvester and N. L. Willard, representatives for Colorado, Utah and Wyoming.

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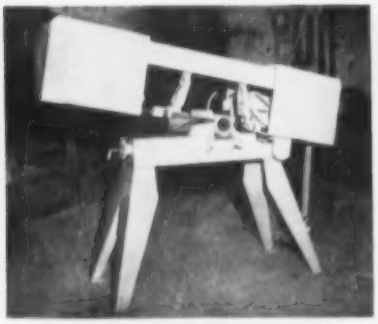

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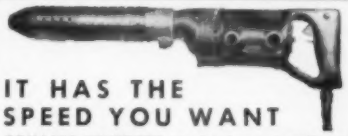

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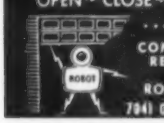

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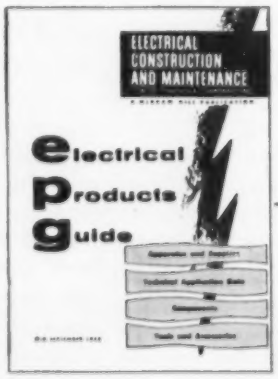


• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

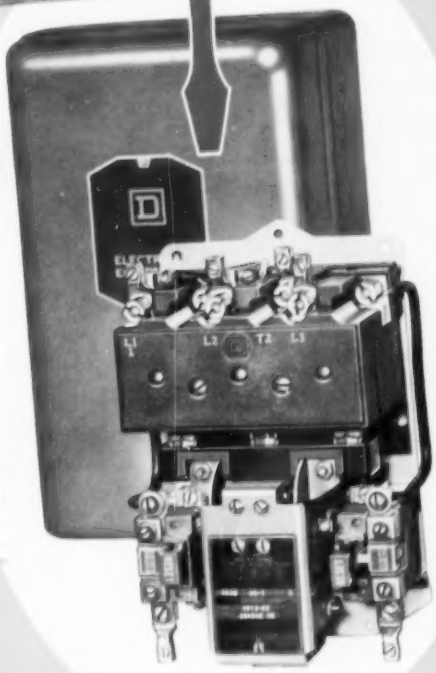
For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

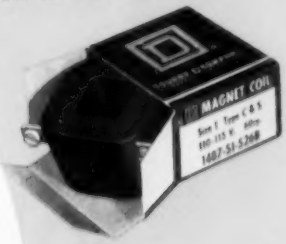
Qwik Change

with PACKAGED MOTOR STARTER PARTS!

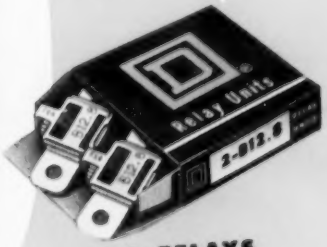
INTERLOCKS
A wide variety of quick-change, front-mounted interlocks adds flexibility for special applications

CONTACTS
Packaged replacement contacts are easily installed without disturbing wiring





COILS
Screwdriver is only tool required for quick change of magnet coil to accommodate different voltages



O.L. RELAYS
A wide variety of easily selected, packaged overload relay heater units provides quick changes to meet varying requirements for overload protection

PUSH BUTTONS AND SELECTOR SWITCH
These Kits contain all parts necessary to make quick changes from standard starters to either push button or selector switch controlled devices

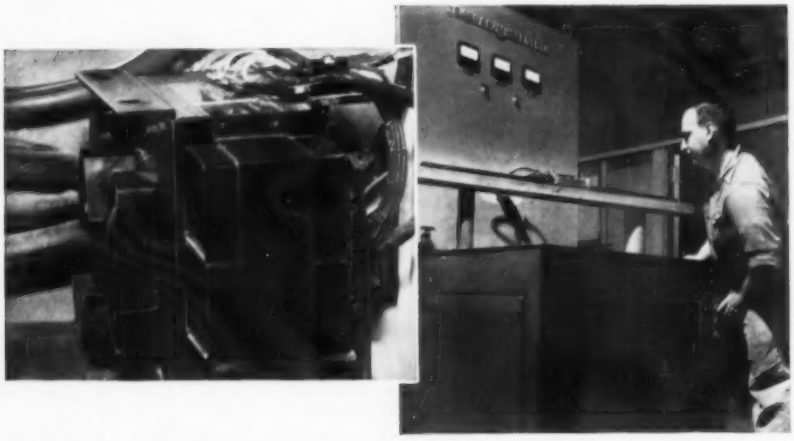
EASY to Identify!
EASY to Buy!
FASTER to Install!

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY

Dry-Type Transformer NEWS

G-E voltage stabilizing transformers featured in new line of electronic induction heaters



G-E voltage stabilizing transformers in new induction heaters assure continuous production.

VOLTAGE CONTROL WITHIN ±3% PERMITS SAVINGS IN MAINTENANCE COSTS

In the design of the Company's new line of electronic induction heaters, G-E engineers considered one fact of primary importance. Fluctuating voltage of just 5% can decrease tube life in electronic induction heaters by as much as 50%. This fact prompted engineers to equip the new induction heater line with field-proven G-E voltage stabilizing transformers. G-E voltage stabilizing transformers hold tube filament voltage to ±3%. Extra-long tube life results to hold down induction heater maintenance costs, and assure continuous heat-treating in metal-working plants.

G.E. Markets New Indoor-Outdoor Dry-type Transformer

G.E.'s Specialty Transformer Department announces the availability of a new extra-quiet, indoor-outdoor 25-kva transformer. Equipped with mounting ears for convenient wall or column mounting, the transformer is specially designed for applications where moisture, dust, lint, are primary factors. Some design features: a phosphatized finish with final coat of G-E Glyptal* alkyd-resin helps prevent rust and corrosion; gaskets between cap and core and between terminal compartments and core are of special weatherproof material; heat is radiated through exposed core, thus eliminating draft through the coils (especially important where corrosive atmospheres are prevalent).

One other point: the new transformer has an unusually low noise level due to vibration-resistant construction. The transformer's low noise level makes it particularly suitable for applications in apartments, offices, hospitals, and in other situations where noise is an important factor. Section 410-22, General Electric Co., Schenectady 5, N. Y.

*Registered trade-mark of the General Electric Company

BUCK-BOOST TRANSFORMERS PERMIT AIR-CONDITIONING OEMS TO STANDARDIZE ON 230-VOLT COMPONENTS

Plenty of interest has been generated in the air-conditioning market by news from G.E. that users and manufacturers can standardize on 230-volt units and still operate from 208-volt distribution systems. Voltage can be boosted from 208 volts to 230 volts with General Electric buck-boost transformers available in ratings to handle any size air-conditioning unit.

Immediate advantage to the user: he can purchase standard 230-volt air conditioners at lower cost than special 208-volt units and match them to his distribution voltage.

Immediate advantage to the manufacturer: he can eliminate dual inventories of 208-volt and 230-volt components.

GENERAL ELECTRIC